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NASA SP-7011 (365)

August 1992

# AEROSPACE MEDICINE AND BIOLOGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES

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BIBLIOGRAPHY WITH INDEXES  
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NASA SP-7011 (365)

August 1992

# **AEROSPACE MEDICINE AND BIOLOGY**

A CONTINUING BIBLIOGRAPHY WITH INDEXES



National Aeronautics and Space Administration  
Scientific and Technical Information Program  
Washington, DC

1992

# INTRODUCTION

This issue of *Aerospace Medicine and Biology* (NASA SP-7011) lists 211 reports, articles and other documents originally announced in July 1992 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. The first issue of *Aerospace Medicine and Biology* was published in July 1964.

Accession numbers cited in this issue are:

STAR (N-10000 Series)	N92-22096 — N92-24070
IAA (A-10000 Series)	A92-32535 — A92-36524

In its subject coverage, *Aerospace Medicine and Biology* concentrates on the biological, physiological, psychological, and environmental effects to which humans are subjected during and following simulated or actual flight in the Earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. Applied research receives the most emphasis, but references to fundamental studies and theoretical principles related to experimental development also qualify for inclusion.

Each entry in the publication consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by *STAR* categories 51 through 55, the Life Sciences division. The citations include the original accession numbers from the respective announcement journals.

Seven indexes—subject, personal author, corporate source, foreign technology, contract, report number, and accession number—are included.

A cumulative index for 1992 will be published in early 1993.

Information on availability of documents listed, addresses of organizations, and NTIS price schedules are located at the back of this issue.

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## TYPICAL REPORT CITATION AND ABSTRACT

NASA SPONSORED  
ON MICROFICHE

ACCESSION NUMBER → **N92-11637\*** # Vanderbilt Univ., Nashville, TN. Dept. of Electrical Engineering. ← CORPORATE SOURCE

TITLE → **ROBOT GRAPHIC SIMULATION TESTBED Final Report**

AUTHORS → **GEORGE E. COOK, JANOS SZTIPANOVITS, CSABA BIEGL, GABOR KARSAI, and JAMES F. SPRINGFIELD** Aug. 1991 ← PUBLICATION DATE

CONTRACT NUMBER → (Contract NAG8-690)

REPORT NUMBERS → (NASA-CR-188998; NAS 1.26:188998) Avail: NTIS HC/MF A06; ← AVAILABILITY SOURCE

PRICE CODE  
COSATI CODE

119 p Original contains color illustrations

12 functional color pages CSCL 06/11

The objective of this research was twofold. First, the basic capabilities of ROBOSIM (graphical simulation system) were improved and extended by taking advantage of advanced graphic workstation technology and artificial intelligence programming techniques. Second, the scope of the graphic simulation testbed was extended to include general problems of Space Station automation. Hardware support for 3-D graphics and high processing performance make high resolution solid modeling, collision detection, and simulation of structural dynamics computationally feasible. The Space Station is a complex system with many interacting subsystems. Design and testing of automation concepts demand modeling of the affected processes, their interactions, and that of the proposed control systems. The automation testbed was designed to facilitate studies in Space Station automation concepts.

Author

## TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT

ACCESSION NUMBER → **A92-10353**

TITLE → **EFFECTS OF HYPOXIA AND COLD ACCLIMATION ON THERMOREGULATION IN THE RAT**

AUTHORS → **H. GAUTIER, M. BONORA, S. B. M'BAREK, and J. D. SINCLAIR** (Paris VI, Universite, France; Auckland, University, New Zealand) ← AUTHORS' AFFILIATION

JOURNAL TITLE → **Journal of Applied Physiology** (ISSN 0161-7567), vol. 71, Oct. 1991, p. 1355-1363. Research supported by Institut National de la Sante et de la Recherche Medicale. refs ← PUBLICATION DATE

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Results are reported from an experimental study tracing the effects of hypoxia on thermoregulation and on the different sources of thermogenesis in rats before and after periods of 1-4 wk of cold acclimation. Measurements of the metabolic rate (VO<sub>2</sub>) and body temperature (T<sub>b</sub>) were made at 5-min intervals, and shivering activity was recorded continuously in groups of rats subjected to three protocols. Recordings were made in normoxia and in hypoxia on different days in the same animals. The results show that: (1) in noncold-acclimated (NCA) rats, cold exposure induced increases in VO<sub>2</sub> and shivering that were proportional to the decrease in T<sub>a</sub>; (2) in cold-acclimated (CA) rats in normoxia, for a given ambient temperature, VO<sub>2</sub> and T<sub>b</sub> were higher than in NCA rats, whereas shivering was generally lower; and (3) in both NCA and CA rats, hypoxia induced a transient decrease in shivering and a sustained decrease in nonshivering thermogenesis associated with a marked decrease in T<sub>b</sub> that was about the same in NCA and CA rats. It is concluded that hypoxia acts on T<sub>b</sub> control to produce a general inhibition of thermogenesis.

P.D.

# AEROSPACE MEDICINE AND BIOLOGY

*A Continuing Bibliography (Suppl. 365)*

August 1992

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## LIFE SCIENCES (GENERAL)

A92-33751

**DEVELOPMENT OF ISOLATED PLANT CELLS IN CONDITIONS OF SPACE FLIGHT (THE PROTOPLAST EXPERIMENT)**  
[RAZVITIE IZOLIROVANNYKH RASTITEL'NYKH KLETOK V USLOVIAKH KOSMICHESKOGO POLETA /EKSPERIMENT 'PROTOPLAST'/]

M. G. TAIRBEKOV (Institut Mediko-Biologicheskikh Problem, Moscow, Russia), E. L. KORDIUM, D. A. KLIMCHUK (AN Ukrainy, Institut Botaniki, Kiev, Ukraine), O. A. ZABOTINA, V. V. LOZOVAIA (Rossiiskaia Akademiia Nauk, Institut Biologii, Kazan, Russia), K. BAGGERUD, T.-H. IVERSEN (Trondheim, University, Norway), O. RASMUSSEN (Aarhus University, Denmark), and F. GMUNDER (Zuerich, Eidgenoessische Technische Hochschule, Zurich, Switzerland) Akademiia Nauk SSSR, *Izvestiia, Seria Biologicheskaiia* (ISSN 0002-3329), Jan.-Feb. 1992, p. 5-17. In Russian. refs

Copyright

Results are presented from the Soviet-ESA experiment Protoplast, in which the effect of a space flight (aboard Cosmos 2044) on the development of protoplasts isolated from 6-day-old hypocotyls of rape (*Brassica napus*) sprouts and from cultured carrot (*Daucus carota*) cells was investigated by postflight examinations of the rape and carrot cells. It was found that, compared with cells that developed on ground, the cells that developed in space had a reduced metabolic activity and exhibited changes of morphological and functional characteristics, including the chemical composition of cell-wall components, decreased protein contents, decreased peroxidase activity, and alterations of cell ultrastructure. Possible mechanisms responsible for these effects are discussed. I.S.

A92-33772

**CHANGES OF SYSTEMIC HEMODYNAMICS AND OF BLOOD CIRCULATION IN SKELETAL MUSCLES OF RATS ADAPTED TO HYPOXIA [IZMENENIIA SISTEMNOI GEMODINAMIKI I KROVENOSNOGO RUSLA SKELETNYKH MYSHTS U KRYs, ADAPTIROVANNYKH K GIPOKSII]**

V. B. KOSHELEV, O. S. TARASOVA, T. P. STOROZHEVYKH, V. S. BARANOV, V. G. PINELIS, and I. M. RODIONOV (Moskovskii Gosudarstvennyi Universitet, Moscow, Russia) *Fiziologicheskii Zhurnal SSSR* (ISSN 0015-329X), vol. 77, Sept. 1991, p. 123-129. In Russian. refs

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The effect of prolonged exposures to hypoxia (2 weeks of 18-20-hr or 2-hr daily exposures to a simulated altitude of 5000 m above sea level) on the central hemodynamics and the structure of blood vessels in skeletal muscles of rats was investigated together with the regulatory effects of these changes. Results showed that adaptation to altitude hypoxia led to complex functional and structural changes in the circulation system. As a result of adaptation, the cardiac output of experimental rats increased by

22 percent, and the total peripheral resistance decreased by the same value. In addition, the vessel reactivity to sympathetic stimulation (but not to exogenous noradrenaline) decreased. I.S.

A92-33773

**THE RESPONSES OF SYSTEMIC AND REGIONAL CIRCULATION TO FUNCTIONAL LOADS DURING ADAPTATION TO HIGH ALTITUDE [REAKTSII SISTEMNOGO I REGIONARNOGO KROVOOBRAZHENIIA NA FUNKTSIONAL'NYE NAGRUZKI PRI ADAPTATSII K VYSOKOGOR'IU]**

S. B. DANILAROV, I. E. KONONETS, O. IA. SCHASTLIVYI, O. N. RAGOZIN, and A. T. ASHIMOV (Kirgizskii Gosudarstvennyi Universitet, Bishkek, Kyrgyzstan) *Fiziologicheskii Zhurnal SSSR* (ISSN 0015-329X), vol. 77, Sept. 1991, p. 130-139. In Russian. refs

Copyright

The effect of adaptation to high-altitude hypoxia (3200 m above sea level) on the responses of systemic and regional circulation to functional loads was investigated in experiments on rats, cats, and human subjects. It was found in rats that the hypoxic resistance of the blood circulation system changed depending on the period of adaptation and the different regimens of cerebral ischemia. Adaptation of rats for 30 days is characterized by increases in tonus and reactivity of the sympathetic branch of the vegetative nervous system and by decreases of these characteristics of the parasympathetic branch. It was also found that cats adapted for 30 days exhibited diastolic and systolic types of hypertension in the minor blood cycle, and alterations of blood pressure responses to postural changes. In humans, 25 days of high-altitude exposures resulted in desynchronization of various parameters of cerebral circulation. I.S.

A92-33774

**THE ANALYSIS OF BAROREFLEX EFFECTS ON THE SYSTEMIC HEMODYNAMICS IN ANTIORTHOSTASIS [ANALIZ BAROREFLEKTORNYKH VLIANII NA SISTEMNUIU GEMODINAMIKU PRI ANTIORTOSTAZE]**

L. I. OSADCHII, T. V. BALUEVA, and I. V. SERGEEV (Rossiiskaia Akademiia Nauk, Institut Fiziologii, St. Petersburg, Russia) *Fiziologicheskii Zhurnal SSSR* (ISSN 0015-329X), vol. 77, Sept. 1991, p. 173-181. In Russian. refs

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In acute experiments on cats, the influence of the carotid-sinus baroreceptors on the systemic hemodynamics was studied under conditions of antiorthostasis (15-45-deg head-down tilt, HDT) applied before and after carotid-artery occlusion procedures. It was found that exposures to HDT increased arterial pressure and the cardiac output, and decreased the heart rate and the total peripheral resistance. The exclusion of baroreceptors (by denervation) of the carotid sinus did not affect the initial shifts in the group with increasing arterial pressure. In the group with decreasing arterial pressure, however, the same procedure was found to reverse the reaction. I.S.

A92-33775

**LOCAL BLOOD FLOW AND OXYGEN TENSION IN THE PIGEON BRAIN UNDER ALTITUDE HYPOXIA [LOKAL'NYI KROVOTOK I NAPRIAZHENIE KISLORODA V MOZGE GOLUBEI PRI VYSOTNOI GIPOKSII]**

ABSTRACTS

N. A. PAVLOV, T. V. FEDOTKINA, M. V. VOROB'EV, and S. P. MARKOVETS (Rossiiskaia Akademiia Nauk, Institut Evoliutsionnoi Fiziologii i Biokhimii, St. Petersburg, Russia) *Fiziologicheskii Zhurnal SSSR* (ISSN 0015-329X), vol. 77, Oct. 1991, p. 40-47. In Russian. refs  
Copyright

**A92-33920\*** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

## **BIOLOGICAL EFFECTIVENESS OF HIGH-ENERGY PROTONS - TARGET FRAGMENTATION**

FRANCIS A. CUCINOTTA (NASA, Langley Research Center, Hampton, VA; Rockwell International Corp., Space Transportation Systems Div., Houston, TX), ROBERT KATZ (Nebraska, University, Lincoln), JOHN W. WILSON, LAWRENCE W. TOWNSEND, JUDY SHINN (NASA, Langley Research Center, Hampton, VA), and FERENC HAJNAL (DOE, Environmental Measurements Laboratory, New York) *Radiation Research* (ISSN 0033-7587), vol. 127, 1991, p. 130-137. Research supported by U.S. Army and DOE. refs  
Copyright

High-energy protons traversing tissue produce local sources of high-linear-energy-transfer ions through nuclear fragmentation. The contribution of these target fragments to the biological effectiveness of high-energy protons using the cellular track model is examined. The effects of secondary ions are treated in terms of the production collision density using energy-dependent parameters from a high-energy fragmentation model. Calculations for mammalian cell cultures show that at high dose, at which intertrack effects become important, protons deliver damage similar to that produced by gamma rays, and with fragmentation the relative biological effectiveness (RBE) of protons increases moderately from unity. At low dose, where sublethal damage is unimportant, the contribution from target fragments dominates, causing the proton effectiveness to be very different from that of gamma rays with a strongly fluence-dependent RBE. At high energies, the nuclear fragmentation cross sections become independent of energy. This leads to a plateau in the proton single-particle-action cross section, below 1 keV/micron, since the target fragments dominate.

Author

**A92-34190\*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

## **ADVANCES IN SPACE BIOLOGY AND MEDICINE. VOL. 1**

SJOERD L. BONTING, ED. (NASA, Ames Research Center; SETI Institute, Moffett Field, CA) Greenwich, CT, JAI Press, Inc., 1991, 350 p. For individual items see A92-34191 to A92-34199. (ISBN 1-55938-296-1) Copyright

Topics discussed include the effects of prolonged spaceflights on the human body; skeletal responses to spaceflight; gravity effects on reproduction, development, and aging; neurovestibular physiology in fish; and gravity perception and circumnutation in plants. Attention is also given to the development of higher plants under altered gravitational conditions; the techniques, findings, and theory concerning gravity effects on single cells; protein crystal growth in space; and facilities for animal research in space. I.S.

**A92-34192\*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

## **SKELETAL RESPONSES TO SPACEFLIGHT**

EMILY R. MOREY-HOLTON and SARA B. ARNAUD (NASA, Ames Research Center, Moffett Field, CA) IN: *Advances in space biology and medicine*. Vol. 1. Greenwich, CT, JAI Press, Inc., 1991, p. 37-69. refs  
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The effect of gravity on the skeletal development and on the bone composition and its regulation in vertebrates is discussed. Results are presented from spaceflight and ground studies in both man and rat on the effect of microgravity on the bone-mineral metabolism (in both species) and on bone maturation and growth (in rats). Special attention is given to a ground-based flight-simulation rat model developed at NASA's Ames Research Center for studies of bone structure at the molecular, organ, and

whole-body levels and to comparisons of estimated results with spaceflight data. I.S.

**A92-34193\*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

## **GRAVITY EFFECTS ON REPRODUCTION, DEVELOPMENT, AND AGING**

JAIME MIQUEL (Alicante, Universidad, Spain) and KENNETH A. SOUZA (NASA, Ames Research Center, Moffett Field, CA) IN: *Advances in space biology and medicine*. Vol. 1. Greenwich, CT, JAI Press, Inc., 1991, p. 71-97. refs  
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The effects of various levels of gravity force (obtained by rotation in clinostats or by centrifugation) and the near-weightlessness condition aboard orbiting spacecraft on the fertilization, embryonic development, maturation, and aging of animals are examined. Results obtained from the American and Soviet spaceborne biology experiments are presented including those on mammals, amphibians, fish, birds, invertebrates, and protozoa. Theoretical issues related to the effect of gravity on various physiological systems are discussed together with the future research goals concerning human life in space. It is noted that life in space (after adaptation to near-weightlessness) might be significantly prolonged due to a reduction in metabolic rate and a concomitant decrease in oxygen radical reactions. I.S.

**A92-34194**

## **NEUROVESTIBULAR PHYSIOLOGY IN FISH**

SATORU WATANABE, AKIRA TAKABAYASHI, MASAFUMI TANAKA, and DAI YANAGIHARA (Nagoya University, Japan) IN: *Advances in space biology and medicine*. Vol. 1. Greenwich, CT, JAI Press, Inc., 1991, p. 99-128. refs  
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Results are presented from experiments on the behavior of fish in microgravity conditions. It is noted that, although the abnormal behavior of fish in weightlessness can be explained by the loss of the otolith function alone, the behavior exhibited by a labyrinthectomized fish in microgravity during a parabolic flight point to the role of other gravity sensors, such as the swimming bladder and the lateral line organs. Results of investigations of the dorsal light response (DLR) of fish in experiments involving the effects of the ablation of brain sections on the DLR indicated that the highest center operating in the visual-vestibular interaction in the DLR of the goldfish is the valvula cerebelli. Two hypotheses are proposed to explain the mechanism of the DLR: the tonus asymmetry principle and the telotactic principle of Von Holst. I.S.

**A92-34195**

## **GRAVITY PERCEPTION AND CIRCUMNUTATION IN PLANTS**

ALLAN H. BROWN (Gravitational Plant Physiology Laboratory, Philadelphia, PA) IN: *Advances in space biology and medicine*. Vol. 1. Greenwich, CT, JAI Press, Inc., 1991, p. 129-153. refs  
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The aspects of plant gravitropism relevant for understanding the mechanism(s) responsible for circular movements of growing plant organs (circumnutations) are discussed. Special attention is given to two models of circumnutation, the old internal oscillator model of Darwin and Darwin (1909), according to which circumnutation is automatic and due to internal stimuli, and the gravitropic response-with-overshoot model proposed by Israelsson and Johnsson (1967), according to which the driver in circumnutation is the force of gravity. Tests aboard the Spacelab demonstrated that gravity force is not an obligatory requirement for circumnutation, and further analyses of results from clinostat experiments, satellite orbit studies, and studies on the morphology and function of plasmodesmata led to the development of a model that has all the properties of Darwin's internal oscillator model. I.S.

**A92-34196**

## **DEVELOPMENT OF HIGHER PLANTS UNDER ALTERED GRAVITATIONAL CONDITIONS**

A. MERKYS and R. LAURINAVICIUS (Lithuanian Academy of Sciences, Institute of Botany, Vilnius, Lithuania) IN: *Advances in space biology and medicine*. Vol. 1. Greenwich, CT, JAI Press, Inc., 1991, p. 155-181. refs

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Results from space and ground studies are used to analyze the effects of hyper- and hypogravity in the development of higher plants in terms of the structural and functional rearrangements occurring on the level of cell, organ, and organism due to changes of gravitational force. It was found that the greatest structural changes take place in the cytoplasm of gravireceptor cells, where the statoliths alter their usual localization dependent on the direction and the magnitude of gravity force. However, the seed germination, morphogenesis, and early phases of the seedlings grown under microgravity follow their normal course, in spite of some changes in the structures and functions observed on the levels of cell, organ, and organism. Changes occurring in plant roots (such as the reduction of the number of meristemic cells and their faster transition to extension and differentiation) do not prevent the development to mature plants, the seed-to-seed growth, and the formation of biologically viable seeds during spaceflight. I.S.

#### A92-34197

##### GRAVITY EFFECTS ON SINGLE CELLS - TECHNIQUES, FINDINGS, AND THEORY

AUGUSTO COGOLI and FELIX K. GMUENDER (Zuerich, Eidgenossische Technische Hochschule, Zurich, Switzerland) IN: *Advances in space biology and medicine*. Vol. 1. Greenwich, CT, JAI Press, Inc., 1991, p. 183-248. Research supported by Eidgenossische Technische Hochschule Zuerich, SNSF, and ESA. refs

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The equipment and the techniques used to study the effect of gravity on single cells are discussed together with the results of studies on the mechanisms of gravity effects. Special attention is given to the specifications of several spaceborne incubators, including Biotherm (on Salyut-4), Biotherm-1 (Salyut-5), Cytos 1 (Salyut-6), Cytos 2 (Salyut-7), Carry-On (STS-8), and Biorack (SL D-1, 1 ML-1). Also examined are bioreactors, including Woodlawn Wanderer-9 (Spacelab); DCCS (Biocosmos IX, IML-1); JSC (Shuttle); JPL (Space Station), and Biolab (Space Station). A summary of the effects of a spaceflight and/or centrifugation on bacteria, algae, plant cells, protozoa, and mammalian cells is presented. I.S.

A92-34199\* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

##### FACILITIES FOR ANIMAL RESEARCH IN SPACE

SJOERD L. BONTING (NASA, Ames Research Center; SETI Institute, Moffett Field, CA), JENNY S. KISHIYAMA, and ROGER D. ARNO (NASA, Ames Research Center, Moffett Field, CA) IN: *Advances in space biology and medicine*. Vol. 1. Greenwich, CT, JAI Press, Inc., 1991, p. 279-325. refs

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The animal facilities used aboard or designed for various spacecraft research missions are described. Consideration is given to the configurations used in Cosmos-1514 (1983) and Cosmos-1887 (1987) missions; the reusable Biosatellite capsule flown three times by NASA between 1966 and 1969; the NASA's Lifesat spacecraft that is being currently designed; the Animal Enclosure Module flown on Shuttle missions in 1983 and 1984; the Research Animal Holding Facility developed for Shuttle-Spacelab missions; the Rhesus Research Facility developed for a Spacelab mission; and the Japanese Animal Holding Facility for the Space Station Freedom. Special attention is given to the designs of NASA's animal facilities developed for Space Station Freedom and the details of various subsystems of these facilities. The main characteristics of the rodent and the primate habitats provided by these various facilities are discussed. I.S.

#### A92-34258

##### RECOVERY OF THE HYPOXIC VENTILATORY DRIVE OF RATS FROM THE TOXIC EFFECT OF HYPERBARIC OXYGEN

D. WAISMAN, R. ARIELI, D. KEREM, and Y. MELAMED (Carmel Hospital; Israeli Naval Hyperbaric Institute, Haifa, Israel) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 63, April 1992, p. 280-286. refs

Copyright

Hyperbaric oxygen (HBO) exposure reduces the hypoxic ventilatory drive (HVD), probably by damaging the carotid bodies. The recovery of the HVD from HBO exposure was studied. The HVD was calculated from whole body plethysmographic recordings of the ventilatory response to less than 85 percent and 2 percent O<sub>2</sub> in N<sub>2</sub> mixtures. Five groups of rats were exposed to HBO for 9 h at pressures of 1.9, 2.0, 2.1, 2.2, and 2.4 ATA, respectively. Each rat underwent three control measurements on different days prior to HBO exposures and then at various intervals following the exposure. Postexposure HVD was reduced to 28 percent of control values in the high Po<sub>2</sub>s. Ninety percent recovery of preexposure HVD was evident by 12-48 h although in some animals exposed to relatively low Po<sub>2</sub>s (1.9 and 2.0 ATA) HVD stabilized at a level lower than 100 percent. The recovery of the HVD stabilized at a level lower than 100 percent. The recovery of the HVD in percent during the first 4 d following exposure can be expressed as an exponential function of the time from the termination of HBO:  $HVD = 28 + 72(1 - \exp -0.053t)$  (t in hours). This information may be of importance in cases of repeated exposures to HBO where one tries to avoid cumulative damage to the carotid bodies, and in the care of the poorly oxygenated patient after HBO treatment. Author

#### A92-34259

##### CHANGES IN STRIATAL AND CORTICAL AMINO ACID AND AMMONIA LEVELS OF RAT BRAIN AFTER ONE HYPERBARIC OXYGEN-INDUCED SEIZURE

P. MIALON (Bretagne Occidentale, Universite, Brest, France), R. GIBEY (Centre Hospitalier Universitaire, Besancon, France), J. C. BIGOT (Centre Hospitalier Universitaire, Brest, France), and L. BARTHELEMY (Bretagne Occidentale, Universite, Brest, France) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 63, April 1992, p. 287-291. refs

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Changes in amino acids (AA) and ammonia were investigated in the cerebral cortex and striatum of rats after the following conditions: (1) one hyperbaric oxygen (HBO)-induced seizure (6 ATA O<sub>2</sub>); (2) exposure to 6 ATA air; and (3) exposure to atmospheric pressure (no seizures in both latter groups). Exposure to 6 ATA air produced no change with respect to atmospheric pressure. After HBO seizure, AA levels (except for gamma-amino butyric acid, GABA, and glutamine), with respect to 6 ATA air levels, were altered in the striatum with a concomitant rise in ammonia (+70 percent) at variance with the cortex. These changes could be explained by increased oxidative deamination in the striatum. Decrease in taurine content (-66 percent) in the striatum, where HBO lipoperoxidation exists, suggests an alteration of glial function leading to blockade of uptake and loss of released products in interstitial fluid. This pattern of change recalls the one seen in ischemic conditions, but cannot be confirmed in the absence of measurements of extracellular amino acid levels under HBO conditions. The maintenance in the level of GABA would favor its role in controlling seizure. In the cortex, only a few AA levels decreased, along with a nonsignificant trend for ammonia to increase. The remaining abnormalities in the striatum, after the first HBO seizure, may explain the already known repetition of seizures in continuously exposed animals and are consistent with previous data on the important role of the striatum. Author

A92-35352\* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

##### TRAINING-INDUCED ALTERATIONS IN YOUNG AND SENESCENT RAT DIAPHRAGM MUSCLE

LUC E. GOSSELIN, MICHAEL BETLACH, ARTHUR C. VAILAS, and D. P. THOMAS (Wisconsin, University, Madison; Wyoming,

## 51 LIFE SCIENCES (GENERAL)

University, Laramie) Journal of Applied Physiology (ISSN 8750-7587), vol. 72, no. 4, April 1992, p. 1506-1511. Research supported by University of Wisconsin. refs  
(Contract NAG2-568)  
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The effect of progressive treadmill exercise on oxidative capacity in three specific diaphragm muscle fiber types and on the capillary density of known fiber types was investigated in young (5 month) and senescent (23 months or older) rats. All animals were trained for 1 hr/day, 5 days weekly, for 10 weeks. Measurements of succinate dehydrogenase activity showed significant increases in all three fiber types in both the young and the senescent trained animals, compared with their sedentary controls. Fiber size and capillary density were not affected by exercise or age. The results demonstrate that the senescent costal diaphragm maintains its ability to adapt to an increased metabolic demand brought about by locomotor exercises. I.S.

**A92-35524**

### **RECOGNITION OF PALEOBIOCHEMICALS BY A COMBINED MOLECULAR SULFUR AND ISOTOPE GEOCHEMICAL APPROACH**

MATH E. L. KOHNEN (Koninklijke/Shell Exploratie en Productie Laboratorium, Rijswijk, Netherlands), STEFAN SCHOUTEN, JAAP S. S. DAMSTE, JAN W. DE LEEUW (Delft University of Technology, Netherlands), DAWN A. MERRITT, and J. M. HAYES (Indiana University, Bloomington) Science (ISSN 0036-8075), vol. 256, no. 5055, April 17, 1992, p. 358-362. Research supported by Netherlands Foundation for Earth Science Research and NWO. refs

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Study of organic matter in immature sediments from a Messinian evaporitic basin shows that consideration of structures, modes of occurrence, and carbon isotopic compositions of free and sulfur-bound carbon skeletons allow identification of biochemical precursors. Detailed information concerning biotic communities present during deposition of sediments can be retrieved in this way. Moreover, unprecedented biochemicals were recognized; these extend the horizon of biomarker geochemistry. Author

**A92-36135**

### **DYNAMICS OF PROTEIN PRECRYSTALLIZATION CLUSTER FORMATION**

YANNIS GEORGALIS, ATHINA ZOUNI, and WOLFRAM SAENGER (Berlin, Freie Universitaet, Federal Republic of Germany) Journal of Crystal Growth (ISSN 0022-0248), vol. 118, no. 3-4, April 1992, p. 360-364. Research supported by DFG and BMFT. refs

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In the initial stages of crystallization of hen egg-white lysozyme, monomers aggregate quickly and form large precrystallization fractal clusters, as observed by photon correlation spectroscopy. Under supersaturation conditions low quality crystals appear after long periods of incubation in the crossover regime, whereas large, strongly X-ray diffracting crystals are obtained after a few hours from clusters growing in the diffusion limited regime. It is proposed that, via observation of parameters such as the growth regime, the limiting size of the clusters and the resulting growth exponents, the fate of a protein solution undergoing crystallization can be predicted and optimized in its very early stages. R.E.P.

**A92-36299\*** National Aeronautics and Space Administration, Washington, DC.

### **THE EARLY EVOLUTION OF EUKARYOTES - A GEOLOGICAL PERSPECTIVE**

ANDREW H. KNOLL (Harvard University, Cambridge, MA) Science (ISSN 0036-8075), vol. 256, no. 5057, May 1, 1992, p. 622-627. Research supported by NASA and NSF. refs

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This paper examines the goodness of fit between patterns of biological and environmental history implied by molecular phylogenies of eukaryotic organisms and the geological records of early eukaryote evolution. It was found that Precambrian geological records show evidence that episodic increases in

biological diversity roughly coincided with episodic environmental changes and by sharp increases in atmospheric oxygen concentrations which significantly changed the earth surface environments. Although the goodness of fit among physical and biological changes is gratifyingly high, the records of these changes do not always coincide in time. The additional information in these fields that is needed for complete integration of geological and phylogenetic records is suggested. I.S.

**A92-36316\*** National Aeronautics and Space Administration, Washington, DC.

### **THE CARBON ISOTOPE BIOGEOCHEMISTRY OF ACETATE FROM A METHANOGENIC MARINE SEDIMENT**

N. E. BLAIR and W. D. CARTER, JR. (North Carolina State University, Raleigh) Geochimica et Cosmochimica Acta (ISSN 0016-7037), vol. 56, no. 3, March 1992, p. 1247-1258. refs  
(Contract NAGW-838)

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The delta C-13 value of porewater acetate isolated from the anoxic sediments of Cape Lookout Bight (North Carolina) ranged from -17.6 percent in the sulfate reduction zone to -2.8 percent in the underlying methanogenic zone. The large C-13 enrichment in the sulfate-depleted sediments appears to be associated with the dissimilation of acetate to CH<sub>4</sub> and CO<sub>2</sub>. Fractionation factors for that process were estimated to be 1.032 +/- 0.014 and 1.036 +/- 0.019 for the methyl and carboxyl groups. A subsurface maximum in delta C-13 of the total acetate molecule, as well as the methyl and carboxyl carbons at 10-15 cm depth within the sediment column, indicate that changes in the relative rates of acetate cycling pathways occur in the methanogenic zone. The methyl group of the acetate was depleted in C-13 by 7-14 percent relative to the carboxyl moiety. The intramolecular heterogeneity may be the result of both synthetic and catabolic isotope effects. Author

**N92-22263** Cornell Univ., Ithaca, NY.

### **EXTRATERRESTRIAL ORGANIC MOLECULES, THE HEAVY BOMBARDMENT, AND THE TERRESTRIAL ORIGINS OF LIFE Ph.D. Thesis**

CHRISTOPHER FRANK CHYBA 1991 275 p

Avail: Univ. Microfilms Order No. DA9203903

The origins of life on Earth coincided with the end of the heavy bombardment of the inner Solar System. Sufficiently large and fast impacts during this bombardment would have eroded planetary atmospheres. The very largest impacts could have led to an 'impact frustration' of the origins of life. Simultaneously, volatile rich impactors delivered elements essential for life to planetary surfaces. Moreover, comets and carbonaceous asteroids are known to be rich in organic molecules, and may therefore have contributed directly to planetary prebiotic organic inventories. The lunar cratering record is used to constrain the importance of each of these effects for the early Earth. Uncertainties in fitting the lunar data are explicitly addressed, and resulting ambiguities in previous work is studied. The pyrolysis of exogenous organics within comets and asteroids traversing the terrestrial atmosphere and impacting Earth's surface is modeled in detail. The 3.4 micron infrared feature observed in comet Halley is modeled as thermal emission from submicron organic grains in the cometary coma. Good agreement with spacecraft determined optical depths is obtained, and specific predictions about the heliocentric evolution of cometary infrared spectra are made. Dissert. Abstr.

**N92-22287#** Joint Publications Research Service, Arlington, VA. JPRS REPORT: SCIENCE AND TECHNOLOGY. CENTRAL EURASIA: LIFE SCIENCES

13 Feb. 1992 45 p Transl. into ENGLISH from various Russian articles

(JPRS-ULS-92-006) Avail: NTIS HC/MF A03

A bibliography is given of science and technology research in Central Eurasian countries. Topics covered include biochemistry, biophysics, epidemiology, genetics, immunology, clinical medicine, microbiology, pharmacology, toxicology, physiology, public health, radiation biology, and virology. Author

**N92-22288#** Joint Publications Research Service, Arlington, VA.  
**JPRS REPORT: SCIENCE AND TECHNOLOGY. CENTRAL EURASIA: LIFE SCIENCES**

11 Feb. 1992 98 p Transl. into ENGLISH from various Russian articles

(JPRS-ULS-92-005) Avail: NTIS HC/MF A05

A bibliography is given of science and technology research in Central Eurasian countries in science and technology. Topics covered include agricultural science, biochemistry, environment, epidemiology, genetics, medicine, pharmacology, toxicology, physiology, public health, psychology, radiation biology, and veterinary medicine.

Author

**N92-22306#** Joint Publications Research Service, Arlington, VA.  
**JPRS REPORT: SCIENCE AND TECHNOLOGY. CENTRAL EURASIA: LIFE SCIENCES**

28 Feb. 1992 34 p Transl. into ENGLISH of various Russian articles

(JPRS-ULS-92-008) Avail: NTIS HC/MF A03

A bibliography is given of Central Eurasian research in life sciences. Topics covered include agriculture, biotechnology, immunology, laser treatment of cancer patients, microbiology, radiation effects, physiology, public health, radiation biology, and veterinary biology.

Author

**N92-22307#** Joint Publications Research Service, Arlington, VA.  
**JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: LIFE SCIENCES**

23 Dec. 1991 66 p Transl. into ENGLISH of various Russian articles

(JPRS-ULS-91-025) Avail: NTIS HC/MF A04

A bibliography of USSR research in life sciences is given. Topics covered include biophysics, epidemiology, immunology, laser bioeffects, medicine, microbiology, physiology, public health, and radiation biology.

Author

**N92-22308#** Joint Publications Research Service, Arlington, VA.  
**JPRS REPORT: SCIENCE AND TECHNOLOGY. CENTRAL EURASIA: LIFE SCIENCES**

14 Jan. 1992 82 p Transl. into ENGLISH of various Russian articles

(JPRS-ULS-92-002) Avail: NTIS HC/MF A05

A bibliography is given of Central Eurasian research in life sciences. Topics covered include medicine, microbiology, pharmacology, toxicology, physiology, public health, radiation biology, veterinary medicine, and virology.

Author

**N92-22309#** Joint Publications Research Service, Arlington, VA.  
**JPRS REPORT: SCIENCE AND TECHNOLOGY. CENTRAL EURASIA: LIFE SCIENCES**

28 Jan. 1992 55 p Transl. into ENGLISH of various Russian articles

(JPRS-ULS-92-003) Avail: NTIS HC/MF A04

A bibliography is given of Central Eurasian research in life sciences. Topics covered include aerospace medicine, agriculture, biotechnology, epidemiology, laser effects, military medicine, toxicology, physiology, public health, psychology, and virology.

Author

**N92-22311#** Joint Publications Research Service, Arlington, VA.  
**JPRS REPORT: SCIENCE AND TECHNOLOGY. CENTRAL EURASIA: LIFE SCIENCES**

19 Jan. 1992 33 p Transl. into ENGLISH from various Russian articles

(JPRS-ULS-92-004) Avail: NTIS HC/MF A03

A bibliography of Central Eurasian research in life sciences is given. Topics covered include agriculture, biochemistry, epidemiology, immunology, physiology, public health, and virology.

Author

**N92-22391#** Joint Publications Research Service, Arlington, VA.  
**JPRS REPORT: SCIENCE AND TECHNOLOGY. CENTRAL EURASIA: LIFE SCIENCES**

9 Mar. 1992 34 p Transl. into ENGLISH from various Russian articles

(JPRS-ULS-92-009) Avail: NTIS HC/MF A03

A bibliography is given of Central Eurasian research in the life sciences. Topics covered include aerospace medicine, agriculture, biotechnology, epidemiology, genetics, laser bioeffects, microbiology, pharmacology, physiology, public health, and radiation biology.

Author

**N92-22393#** Joint Publications Research Service, Arlington, VA.  
**JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: LIFE SCIENCES**

3 Jan. 1992 31 p Transl. into ENGLISH from various Russian articles

(JPRS-ULS-92-001) Avail: NTIS HC/MF A03

A bibliography is given of U.S.S.R. research in life sciences. Topics covered include agriculture, biochemistry, biotechnology, epidemiology, genetics, immunology, industrial medicine, and laser biophysics.

Author

**N92-22430\*#** Forest Service, Delaware, OH. Forestry Sciences Lab.

**ENHANCEMENT OF BIOLOGICAL CONTROL AGENTS FOR USE AGAINST FOREST INSECT PESTS AND DISEASES THROUGH BIOTECHNOLOGY**

JAMES M. SLAVICEK *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 p 51-58 Dec. 1991

Avail: NTIS HC/MF A23 CSCL 06C

Research and development efforts in our research group are focused on the generation of more efficacious biological control agents through the techniques of biotechnology for use against forest insect pests and diseases. Effective biological controls for the gypsy moth and for tree fungal wilt pathogens are under development. The successful use of Gypchek, a formulation of the *Lymantria dispar* nuclear polyhedrosis virus (LdNPV), in gypsy moth control programs has generated considerable interest in that agent. As a consequence of its specificity, LdNPV has negligible adverse ecological impacts compared to most gypsy moth control agents. However, LdNPV is not competitive with other control agents in terms of cost and efficacy. We are investigating several parameters of LdNPV replication and polyhedra production in order to enhance viral potency and efficacy thus mitigating the current disadvantages of LdNPV for gypsy moth control, and have identified LdNPV variants that will facilitate these efforts. Tree endophytic bacteria that synthesize antifungal compounds were identified and an antibiotic compound from one of these bacteria was characterized. The feasibility of developing tree endophytes as biological control agents for tree vascular fungal pathogens is being investigated.

Author

**N92-22431\*#** Brookhaven National Lab., Upton, NY. Biology Dept.

**USE OF T7 RNA POLYMERASE TO DIRECT EXPRESSION OF OUTER SURFACE PROTEIN A (OSP) FROM THE LYME DISEASE SPIROCHETE, BORRELIA BURGDORFERI**

JOHN J. DUNN and BARBARA N. LADE *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 p 59-64 Dec. 1991

Avail: NTIS HC/MF A23 CSCL 06C

The OspA gene from a North American strain of the Lyme disease Spirochete, *Borrelia burgdorferi*, was cloned under the control of transcription and translation signals from bacteriophage T7. Full-length OspA protein, a 273 amino acid (31kD) lipoprotein, is expressed poorly in *Escherichia coli* and is associated with the insoluble membrane fraction. In contrast, a truncated form of OspA lacking the amino-terminal signal sequence which normally would direct localization of the protein to the outer membrane is expressed at very high levels (less than or equal to 100 mg/liter) and is soluble. The truncated protein was purified to homogeneity and is being tested to see if it will be useful as an immunogen in a vaccine against Lyme disease. Circular dichroism and fluorescence spectroscopy was used to characterize the secondary structure

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and study conformational changes in the protein. Studies underway with other surface proteins from *B. burgdorferi* and a related spirochete, *B. hermsii*, which causes relapsing fever, leads us to conclude that a strategy similar to that used to express the truncated OspA can provide a facile method for producing variations of *Borrelia* lipoproteins which are highly expressed in *E. coli* and soluble without exposure to detergents. Author

**N92-22700\*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

### **THE ROTATING SPECTROMETER: BIOTECHNOLOGY FOR CELL SEPARATIONS**

DAVID A. NOEVER *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 p 202-211 Dec. 1991 Previously announced as N91-15673

Avail: NTIS HC/MF A22 CSCL 06C

An instrument for biochemical studies, called the rotating spectrometer, separates previously inseparable cell cultures. The rotating spectrometer is intended for use in pharmacological studies which require fractional splitting of heterogeneous cell cultures based on cell morphology and swimming behavior. As a method to separate and concentrate cells in free solution, the rotating method requires active organism participation and can effectively split the large class of organisms known to form spontaneous patterns. Examples include the biochemical star, an organism called *Tetrahymena pyriformis*. Following focusing in a rotating frame, the separation is accomplished using different radial dependencies of concentrated algal and protozoan species. The focusing itself appears as concentric rings and arises from the coupling between swimming direction and Coriolis forces. A dense cut is taken at varying radii, and extraction is replenished at an inlet. Unlike standard separation and concentrating techniques such as filtration or centrifugation, the instrument is able to separate motile from immotile fractions. For a single pass, typical split efficiencies can reach 200 to 300 percent compared to the inlet concentration.

Author

**N92-22729\*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

### **STRUCTURAL MODIFICATION OF POLYSACCHARIDES: A BIOCHEMICAL-GENETIC APPROACH**

ROGER G. KERN and GENE R. PETERSEN *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 p 480-485 Dec. 1991 Sponsored in part by Defense Advanced Research Projects Agency

Avail: NTIS HC/MF A22 CSCL 06C

Polysaccharides have a wide range of industrial and biomedical applications. An industry trend is underway towards the increased use of bacteria to produce polysaccharides. Long term goals of this work are the adaptation and enhancement of saccharide properties for electronic and optic applications. In this report we illustrate the application of enzyme-bearing bacteriophage on strains of the enteric bacterium *Klebsiella pneumoniae*, which produces a polysaccharide with the relatively rare rheological property of drag-reduction. This has resulted in the production of new polysaccharides with enhanced rheological properties. Our laboratory is developing techniques for processing and structurally modifying bacterial polysaccharides and oligosaccharides which comprise their basic polymeric repeat units. Our research has focused on bacteriophage which produce specific polysaccharide degrading enzymes. This has led to the development of enzymes generated by bacteriophage as tools for polysaccharide modification and purification. These enzymes were used to efficiently convert the native material to uniform-sized high molecular weight polymers, or alternatively into high-purity oligosaccharides. Enzyme-bearing bacteriophage also serve as genetic selection tools for bacteria that produce new families of polysaccharides with modified structures. Author

**N92-23066#** Academic Center for Dentistry, Amsterdam (Netherlands) Dept. of Oral Cell Biology.

### **EFFECT OF MICROGRAVITY AND MECHANICAL STIMULATION ON THE IN VITRO MINERALIZATION AND RESORPTION OF FETAL MOUSE LONG BONES**

J. P. VELDHUIJZEN and J. J. W. A. VAN LOON *In* Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands p 112-113 Apr. 1991 Repr. from Proceedings of the 4th International Conference on the WEGENER/MEDLAS project, Scheveningen, Netherlands, 7-9 Jun. 1989, Feb. 1990 p 281-300

Avail: NTIS HC/MF A10

Preparations of the IML-1 (International Microgravity Laboratory) mission, the Experiment Sequence Test (EST), the hardware performance during the experiment and the testing of the 130 bar pressurized containers for leakages or pressure increase after the experiment, are considered. Inspection of cultured bones showed that normal growth and mineralization had occurred. In some cases the expected mineralization under compression was absent. Preparations and preliminary experiments for the Bion-10 mission are considered. The aim of this mission is to study histologically the mineralization and resorption of mouse long bones after 3 and 6 days of microgravity. ESA

**N92-23067#** Hubrecht Lab., Utrecht (Netherlands).

### **ROLE OF GRAVITY IN THE ESTABLISHMENT OF THE DORSO-VENTRAL AXIS IN THE AMPHIBIAN EMBRYO**

G. A. UBBELS, S. C. J. KERKVIET, and J. M. NARRAWAY *In* Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands p 114-117 Apr. 1991

Avail: NTIS HC/MF A10

A project to analyze early *Xenopus* development is considered. An experiment to take place during the IML-1 (International Microgravity Laboratory) Space Shuttle mission, which considers the role of gravity on the establishment of the spatial structure of the amphibian embryo, is outlined. Problems encountered during the 'Experiment Sequence Test', an obligatory activity of participants of the IML-1 mission are described and solutions given. ESA

**N92-23068#** Utrecht State Univ. (Netherlands). Dept. of Molecular Cell Biology.

### **REGULATION OF CELL GROWTH AND DIFFERENTIATION BY MICROGRAVITY**

P. J. RIJKEN, R. P. DEGROOT, J. BOONSTRA, W. KRUIJER, A. J. VERKLEIJ, and S. W. DELAAT (Hubrecht Lab., Utrecht, Netherlands) *In* Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands p 118-120 Apr. 1991

Avail: NTIS HC/MF A10

To study the effects of variations in gravity on human cells at the molecular level, the well characterized Epidermal Growth Factor (EGF) induced signal transduction in A431 epidermoid carcinoma cells was used as a model system. The influence of gravity on EGF induced EGF receptor clustering and early gene expression was investigated. The results indicate a gravity dependent modulation of EGF and TPA (12-O Tetradecanoyl Phorbol Acetate) induced signal transduction. However, one of the first cellular responses to EGF, that of EGF receptor clustering appears not to be influenced by altered gravity conditions. Thus, gravity may find its targets intracellularly and not at the level of the plasma membrane. Additional evidence of specific gravity targets in the cell, is the observation that not all intracellular pathways that lead to early gene expression are sensitive to altered gravity conditions. ESA

**N92-23069#** Amsterdam Univ. (Netherlands). Dept. of Molecular Cell Biology.

### **EFFECTS OF MICROGRAVITY ON THE PLASMA MEMBRANE-CYTOSKELETON INTERACTIONS DURING CELL DIVISION IN CHLAMYDOMONAS Abstract Only**

H. VANDENENDE *In* Space Research Organization Netherlands,



Activities Report of the Space Research Organization Netherlands p 121 Apr. 1991

Avail: NTIS HC/MF A10

Preparations for an experiment to be flown in the Bion-10 satellite to study the effects of microgravity on cell division in the unicellular green algae *Chlamydomonas* are considered. The nature of the interaction between the plasma membrane and the microtubules will be investigated by disturbing the properties of the plasma membrane and the polar cellular distribution of the cell division apparatus by microgravity. Reasons for the use of *Chlamydomonas* are given. ESA

**N92-23070#** Amsterdam Univ. (Netherlands). Dept. of Molecular Cell Biology.

**BACTERIAL PROLIFERATION UNDER MICROGRAVITY CONDITIONS**

C. L. WOLDRINGH and M. A. J. M. VANBAKEL /in Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands p 122-124 Apr. 1991

Avail: NTIS HC/MF A10

Preparations for a study in which the proliferation of *Escherichia coli* cells under microgravity conditions will be studied are discussed. The hardware for the culturing of the cells, plastic bags with a volume of 700 to 1400 ml, and methods by which growth variation in different bags can be reduced are considered. It is suggested that the bags contain 1400 ml of cell suspension and two ampules, filled with glucose and formaldehyde, respectively. Glucose commences the growth and the formaldehyde enables the cell suspensions to be fixed at the time of sampling. ESA

**N92-23072#** Amsterdam Univ. (Netherlands). Dept. of Otorhinolaryngology.

**THE EFFECT OF MICROGRAVITY ON (1) PUPIL SIZE, (2) VESTIBULAR CALORIC NYSTAGMUS AND (3) THE SWIMMING BEHAVIOUR OF FISH**

W. J. OOSTERVELD, H. A. A. DEJONG, and H. W. KORTSCHOT /in Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands p 129-131 Apr. 1991

Avail: NTIS HC/MF A10

Three projects conducted in parabolic flight are summarized. These include: the effect of linear accelerations on pupil size; study of the horizontal and vertical component of a caloric induced nystagmus; the effect of altered states of gravity on the swimming behavior of fishes. Results of these experiments are given. ESA

**N92-23518#** Oak Ridge National Lab., TN.

**NUCLEAR MEDICINE PROGRAM Progress Report, quarter ending 30 Sep. 1991**

F. F. KNAPP, JR., K. R. AMBROSE, A. P. CALLAHAN, D. W. MCPHERSON, S. MIRZADEH, P. C. SRIVASTAVA, A. HASAN, C. R. LAMBERT, S. J. LAMBERT, and D. E. RICE Feb. 1992

14 p

(Contract DE-AC05-84OR-21400)

(DE92-006979; ORNL/TM-11992) Avail: NTIS HC/MF A03  
Rat tissue distribution properties of 'IQNP', a new radioiodinated cholinergic-muscarinic receptor antagonist, are described. IQNP is the acronym for 1-azabicyclo(2.2.2)oct-3-yl alpha-hydroxy alpha-phenyl alpha (1-iodo-1 propen-30yl) acetate, which is an analogue of the QNB muscarinic antagonist in which the p-iodophenyl moiety has been replaced with the 1-iodo-1-propen-3-yl moiety. The radioiodinated IQNP analogue is easier to prepare in much higher yields than QNB and is thus a candidate for the evaluation of muscarinic receptors by external imaging techniques. Studies in rats demonstrated that IQNP shows high uptake in those cerebral regions rich in muscarinic receptors. QNB-treatment of rats either 1 h before (pre) or 2 h after (post) administration of radioiodinated IQNP resulted in significant displacement or blocking of cerebral specific IQNP uptake (percent dose/gm) in the cortex and striatum. These studies demonstrate that IQNP has specificity for the cholinergic-muscarinic receptor and is a good candidate for further studies. Also during this period, several agents developed in the ORNL Nuclear Medicine Program

were supplied to Medical Cooperative Programs for collaborative studies including the iodine-125-labeled BMIPP and DMIPP fatty acid analogues and the IPM antibody labeling agent. Tin-117m and gold-199 were produced in the ORNL High Flux Isotope Reactor (HFIR) and supplied to the OHER-supported program in the Medical Department at Brookhaven National Laboratory to aid in their research until the re-start of the High Flux Brookhaven Reactor. DOE

**N92-23604\*#** International Center for Genetic Engineering and Biotechnology, Trieste (Italy).

**MICROGRAVITATIONAL EFFECTS ON CHROMOSOME BEHAVIOR (7-IML-1)**

CARLO BRUSCHI /in NASA. Marshall Space Flight Center, First International Microgravity Laboratory Experiment Descriptions p 33-38 Feb. 1992

Avail: NTIS HC/MF A13 CSCL 06C

The effects of the two major space-related conditions, microgravity and radiation, on the maintenance and transmission of genetic information have been partially documented in many organisms. Specifically, microgravity acts at the chromosomal level, primarily on the structure and segregation of chromosomes, in producing major aberrations such as deletions, breaks, nondisjunction, and chromosome loss, and to a lesser degree, cosmic radiation appears to affect the genic level, producing point mutations and DNA damage. To distinguish between the effects from microgravity and from radiation, it is necessary to monitor both mitotic and meiotic genetic damage in the same organism. The yeast *Saccharomyces cerevisiae* is used to monitor at high resolution the frequency of chromosome loss, nondisjunction, intergenic recombination, and gene mutation in mitotic and meiotic cells, to a degree impossible in other organisms. Because the yeast chromosomes are small, sensitive measurements can be made that can be extrapolated to higher organisms and man. The objectives of the research are: (1) to quantitate the effects of microgravity and its synergism with cosmic radiation on chromosomal integrity and transmission during mitosis and meiosis; (2) to discriminate between chromosomal processes sensitive to microgravity and/or radiation during mitosis and meiosis; and (3) to relate these findings to anomalous mitotic mating type switching and ascosporeogenesis following meiosis. Author

**N92-23605\*#** Texas Univ. Health Science Center, Houston. Dental Branch.

**CHONDROGENESIS IN MICROMASS CULTURES OF EMBRYONIC MOUSE LIMB MESENCHYMAL CELLS EXPOSED TO MICROGRAVITY (7-IML-1)**

JACKIE DUKE /in NASA. Marshall Space Flight Center, First International Microgravity Laboratory Experiment Descriptions p 39-44 Feb. 1992

Avail: NTIS HC/MF A13 CSCL 06C

A basic question of space biology is whether changes in gravity are perceived at the cellular level. Previous studies with a variety of cells have shown that this is the case, but to date the response of skeletal cells has not been examined, even though the skeleton is sensitive to gravitational changes. The objective of the CELLS Experiment is to examine the effect of microgravity in vitro on a skeletal cell known to be sensitive to gravitational changes both in vivo and in vitro - the mammalian chondrocyte. Various aspects of the experiment are discussed. Author

**N92-23606\*#** Vrije Univ., Amsterdam (Netherlands). Dept. of Oral Cell Biology.

**EFFECT OF MICROGRAVITY AND MECHANICAL STIMULATION ON THE IN VITRO MINERALIZATION AND RESORPTION OF FETAL MOUSE LONG BONES (7-IML-1)**

J. PAUL VELDHIJZEN /in NASA. Marshall Space Flight Center, First International Microgravity Laboratory Experiment Descriptions p 45-48 Feb. 1992

Avail: NTIS HC/MF A13 CSCL 06C

Mechanical forces play an important role in the differentiation, growth, and remodeling of skeletal tissues. An increase in the normal loading pattern of the skeleton leads to an increase in

bone mass. An overall decrease in the functional load exerted on the skeleton produces mineral loss and osteoporosis. However, the responses of the skeletal tissue cells to various loading conditions are still largely unresolved, as is the mechanism of the cellular response to changed mechanical environment. Using an in vitro approach, we hope to avoid some problems encountered in the use of in vivo animal and man models, which have been extensively used in the past. In a number of experiments we have demonstrated that 16 and 17 day old fetal mouse long bone rudiments (metatarsalia), cultured in a liquid culture medium, are very suitable to study mineralization and resorption, respectively. We have also demonstrated that under hydrostatic compression, mineralization is increased while resorption is decreased. Culture of long bone rudiments under noncompressed control conditions can be regarded as a situation of partial unloading, showing some phenomena of a disuse situation. Under microgravity conditions, responses of osteoblasts and chondrocytes (involved in mineralization) and osteoclasts (involved in mineral resorption), to culture with and without compression, may be much more outspoken. This will have advantages for the study and the interpretation of the role of cellular events in the process of mineralization and resorption of developing skeletal tissues under various loading conditions. The BONES Experiment is carried out in four type I/O and four type I/E containers. Various aspects of the investigation are discussed. Author

**N92-23607\*#** Hubrecht Lab., Utrecht (Netherlands).  
**EGGS: THE ROLE OF GRAVITY IN THE ESTABLISHMENT OF THE DORSO-VENTRAL AXIS IN THE AMPHIBIAN EMBRYO (7-IML-1)**

GEERTJE A. UBBELS /in NASA. Marshall Space Flight Center, First International Microgravity Laboratory Experiment Descriptions p 49-53 Feb. 1992  
 Avail: NTIS HC/MF A13 CSCL 06C

The purpose of this experiment is to fertilize frog (*Xenopus laevis*) eggs under microgravity, to perform histological fixations at two different programmed times, and after return to Earth, to determine whether timing and pattern of egg cleavages and axis formation are normal. Because of the limited viability of the gametes, this experiment will be the very first to be activated in the Biorack. Various aspects of this investigation are discussed. Author

**N92-23608\*#** Consejo Superior de Investigaciones Cientificas, Madrid (Spain). Dept. of Biochemistry.

**THE EFFECT OF SPACE ENVIRONMENT ON THE DEVELOPMENT AND AGING OF DROSOPHILA MELANOGASTER (7-IML-1)**

ROBERTO MARCO /in NASA. Marshall Space Flight Center, First International Microgravity Laboratory Experiment Descriptions p 55-57 Feb. 1992  
 Avail: NTIS HC/MF A13 CSCL 06C

This experiment involves the study of the development of eggs of the fly, *Drosophila*, exposed to microgravity. It is presumed that oogenesis, rather than further states of embryonic development, is sensitive to gravity. This hypothesis will be tested by collecting eggs layered at specific times in flight and postflight from flies exposed to 0 and 1 g. This portion of the experiment is a repetition of an earlier experiment flown in Biorack during the Spacelab D1 Mission. An added feature of the experiment for the First International Microgravity Laboratory (IML-1) Mission is to study the effect of microgravity on the life span of *Drosophila* male flies. Various aspects of the investigation are discussed. Author

**N92-23609\*#** Aarhus Univ. (Denmark).  
**EFFECT OF MICROGRAVITY ENVIRONMENT ON CELL WALL REGENERATION, CELL DIVISIONS, GROWTH, AND DIFFERENTIATION OF PLANTS FROM PROTOPLASTS (7-IML-1)**

OLE RASMUSSEN /in NASA. Marshall Space Flight Center, First International Microgravity Laboratory Experiment Descriptions p 59-61 Feb. 1992  
 Avail: NTIS HC/MF A13 CSCL 06C

The primary goal of this project is to investigate if microgravity has any influence on growth and differentiation of protoplasts. Formation of new cell walls on rapeseed protoplasts takes place within the first 24 hours after isolation. Cell division can be observed after 2-4 days and formation of cell aggregates after 5-7 days. Therefore, it is possible during the 7 day IML-1 Mission to investigate if cell wall formation, cell division, and cell differentiation are influenced by microgravity. Protoplasts of rapeseeds and carrot will be prepared shortly before launch and injected into 0.6 ml polyethylene bags. Eight bags are placed in an aluminum block inside the ESA Type 1 container. The containers are placed at 4 C in PTCU's and transferred to orbiter mid-deck. At 4 C all cell processes are slowed down, including cell wall formation. Latest access to the shuttle will be 12 hours before launch. In orbit the containers will be transferred from the PTC box to the 22 C Biorack incubator. The installation of a 1 g centrifuge in Biorack will make it possible to distinguish between effects of near weightlessness and effects caused by cosmic radiation and other space flight factors including vibrations. Parallel control experiments will be carried out on the ground. Other aspects of the experiment are discussed. Author

**N92-23610\*#** Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.). Inst. for Aerospace Medicine.

**EMBRYOGENESIS AND ORGANOGENESIS OF CARAUSIUS MOROSUS UNDER SPACE FLIGHT CONDITIONS (7-IML-1)**

D. H. BUECKER /in NASA. Marshall Space Flight Center, First International Microgravity Laboratory Experiment Descriptions p 63-64 Feb. 1992  
 Avail: NTIS HC/MF A13 CSCL 06C

The experiment is part of a radiobiological space research program to obtain experimental data on the biological effectiveness of the structured component of cosmic radiation during spaceflight. In this proposed experiment, *Carausius morosus* embryos of different ages will develop under spaceflight conditions. The experiment is designed to determine the influence of galactic heavy ions of very high energy deposition in microgravity on developmental processes of different radiation sensitivity and regenerative capacity. Layers of *Carausius morosus* eggs are sandwiched between different track detectors (cellulose nitrate, CR39). This method allows the localization of the trajectory of each heavy ion in the biological layer and the identification of the site of the penetration inside the egg. Author

**N92-23612\*#** Johann-Wolfgang-Goethe-Univ., Frankfurt am Main (Germany, F.R.). Inst. of Microbiology.

**GROWTH AND SPORULATION OF BACILLUS SUBTILIS UNDER MICROGRAVITY (7-IML-1)**

HORST-DIETER MENNIGMANN /in NASA. Marshall Space Flight Center, First International Microgravity Laboratory Experiment Descriptions p 67-70 Feb. 1992  
 Avail: NTIS HC/MF A13 CSCL 06C

The experiment was aimed at measuring the growth and sporulation of *Bacillus subtilis* under microgravity. The hardware for the experiment consists of a culture chamber (15 ml) made from titanium and closed by a membrane permeable for gases but not for water. Two variants of this basic structure were built which fit into the standard Biorack container types 1 and 2 respectively. Growth of the bacteria will be monitored by continuously measuring the optical density with a built-in miniaturized photometer. Other parameters (viability, sporulation, fine structure, size distribution of cells and spores, growth kinetics, etc.) will be measured on the fixed samples and on those where metabolism was temporarily halted, respectively. Author

**N92-23613\*#** Eidgenoessische Technische Hochschule, Zurich (Switzerland).

**FRIEND LEUKEMIA VIRUS TRANSFORMED CELLS EXPOSED TO MICROGRAVITY IN THE PRESENCE OF DMSO (7-IML-1)**

AUGUSTO COGOLI /in NASA. Marshall Space Flight Center, First International Microgravity Laboratory Experiment Descriptions

p 71-73 Feb. 1992

Avail: NTIS HC/MF A13 CSCL 06C

The purpose of this experiment is to study the adaptation of living cells to microgravity. The *in vitro* transformation of Friend cells by Dimethylsulfoxide (DMSO) is a good model for the study of cell differentiation and protein biosynthesis. Cultures of cells will be prepared shortly before launch. Once in space, transformation will be induced by injection of DMSO. One set of cultures will be chemically fixed with glutaraldehyde for electron microscope investigations; another set will be preserved for determining the amount of hemoglobin produced and the extent of cell proliferation.

Author

**N92-23614\*#** Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. of Biotechnology.

**PROLIFERATION AND PERFORMANCE OF HYBRIDOMA CELLS IN MICROGRAVITY (7-IML-1)**

AUGUSTO COGOLI /In NASA. Marshall Space Flight Center, First International Microgravity Laboratory Experiment Descriptions p 75-77 Feb. 1992

Avail: NTIS HC/MF A13 CSCL 06C

The purpose of this experiment is to study how cell performance (biosynthesis and secretion) is altered by altered gravity conditions. Hybridoma cells are obtained by fusion of an activated B-lymphocyte with a myeloma cell. Activated B-lymphocytes, derived from a human or an animal, carry the information required to produce antibodies of a certain specificity and can survive only a few days in culture. Myeloma cells are tumor cells which can grow indefinitely in culture. Therefore, the product of the fusion is an immortal cell line capable of producing homogeneous antibodies (monoclonal antibodies). Experimental procedures are explained in some detail.

Author

**N92-23615\*#** Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. of Biotechnology.

**DYNAMIC CELL CULTURE SYSTEM (7-IML-1)**

AUGUSTO COGOLI /In NASA. Marshall Space Flight Center, First International Microgravity Laboratory Experiment Descriptions p 79-80 Feb. 1992

Avail: NTIS HC/MF A13 CSCL 06C

This experiment is one of the Biorack experiments being flown on the International Microgravity Laboratory 1 (MIL-1) mission as part of an investigation studying cell proliferation and performance in space. One of the objectives of this investigation is to assess the potential benefits of bioprocessing in space with the ultimate goal of developing a bioreactor for continuous cell cultures in space. This experiment will test the operation of an automated culture chamber that was designed for use in a Bioreactor in space. The device to be tested is called the Dynamic Cell Culture System (DCCS). It is a simple device in which media are renewed or chemicals are injected automatically, by means of osmotic pumps. This experiment uses four Type I/O experiment containers. One DCCS unit, which contains a culture chamber with renewal of medium and a second chamber without a medium supply fits in each container. Two DCCS units are maintained under zero gravity conditions during the on-orbit period. The other two units are maintained under 1 g conditions in a 1 g centrifuge. The schedule for incubator transfer is given.

Author

**N92-23616\*#** Open Univ. (Scotland).

**GROWTH, DIFFERENTIATION AND DEVELOPMENT OF ARABIDOPSIS THALIANA UNDER MICROGRAVITY CONDITIONS (7-IML-1)**

E. P. MAHER and L. G. BRIARTY (Nottingham Univ., England) /In NASA. Marshall Space Flight Center, First International Microgravity Laboratory Experiment Descriptions p 81-87 Feb. 1992

Avail: NTIS HC/MF A13 CSCL 06C

The aim of this set of experiments is to quantify the structural and behavioral changes taking place in germinating seeds of the small plant *Arabidopsis thaliana*. The protocol to be used will involve germination of the seeds in orbit. Their growth will be followed by fixing and photographing samples of microgravity grown and 1 g

control seedlings at intervals over 4 days. The different studies which will then be performed can be classified in relation to the parts of the plants involved. The first study will be an examination of the ultrastructure of the root statocytes, the cells containing gravity sensors, to determine whether their development proceeds normally under microgravity conditions. A second study will examine the differences in root and shoot development and orientation between normal wild type seedlings and those of an agravitropic mutant (*aux-1*) - one that does not respond normally to gravity. A third set of observations will be made on the structural changes occurring during reserve breakdown and utilization in the cells of the cotyledons, the storage organs of the seed. The fourth part of the work will be an examination of the statocytes present in the shoot and their development in microgravity. The final part of the study will give an answer to the debated question of whether the formation of the hypocotyl hook in seedlings is gravity dependent.

Author

**N92-23617\*#** Paris VI Univ. (France).

**TRANSMISSION OF GRAVISTIMULUS IN THE STATOCYTE OF THE LENTIL ROOT (7-IML-1)**

GERALD PERBAL /In NASA. Marshall Space Flight Center, First International Microgravity Laboratory Experiment Descriptions p 89-91 Feb. 1992

Avail: NTIS HC/MF A13 CSCL 06C

The aim of this Biorack experiment is to determine the presentation time (minimum stimulation period to provoke a slight but significant response) of gravireaction of lentil roots cultivated in microgravity for 27 hours. The location of the statoliths in the statocytes will be analyzed in parallel in order to find the cell structure which can transmit the physical effect of the pressure of the statoliths into a biochemical factor leading to an asymmetrical production or release of the inhibitor which is responsible for the gravitropic response. Seeds of *Lens culinaris* will be used because of their small size. Details of the experimental procedure are given.

Author

**N92-23618\*#** Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.).

**GRAVITY RELATED BEHAVIOR OF THE ACELLULAR SLIME MOLD PHYSARUM POLYCEPHALUM (7-IML-1)**

I. BLOCK /In NASA. Marshall Space Flight Center, First International Microgravity Laboratory Experiment Descriptions p 93-97 Feb. 1992

Avail: NTIS HC/MF A13 CSCL 06C

The objective of the experiment is to investigate the effect of near weightlessness on a single cell. The test object is the acellular slime mold *Physarum polycephalum*. This cell is composed of a network of protoplasmic strands which perform rhythmic contractions in the minute range. These contractions of the strands' ectoplasmic walls generate the force to drive the vigorous shuttle streaming of fluid protoplasm inside the strands (hydrostatic pressure flow). A net transport of protoplasm in one direction determines the direction of the cell's locomotion itself. In this way, gravity modifies the contraction rhythm of the strands, the streaming velocity of protoplasm in the strands, and the direction of locomotion of the whole slime mold (geotaxis). The other parts of this experiment will address the major question of how this cell, which does not possess any specialized gravireceptors, gets the information about the direction of the gravity vector. Details of the experimental setup are given.

Author

**N92-23619\*#** Toulouse Univ. (France).

**STUDIES ON PENETRATION OF ANTIBIOTIC IN BACTERIAL CELLS IN SPACE CONDITIONS (7-IML-1)**

R. TIXADOR /In NASA. Marshall Space Flight Center, First International Microgravity Laboratory Experiment Descriptions p 99-107 Feb. 1992

Avail: NTIS HC/MF A13 CSCL 06C

The Cytos 2 experiment was performed aboard Salyut 7 in order to test the antibiotic sensitivity of bacteria cultivated *in vitro* in space. An increase of the Minimal Inhibitory Concentration (MIC) in the inflight cultures (i.e., an increase of the antibiotic resistance)

was observed. Complementary studies of the ultrastructure showed a thickening of the cell envelope. In order to confirm the results of the Cytos 2 experiment, we performed the ANTIBIO experiment during the D1 mission to try to differentiate, by means of the 1 g centrifuge in the Biorack, between the biological effects of cosmic rays and those caused by microgravity conditions. The originality of this experiment was in the fact that it was designed to test the antibiotic sensitivity of bacteria cultivated in vitro during the orbital phase of the flight. The results show an increase in resistance to Colistin in in-flight bacteria. The MIC is practically double in the in-flight cultures. A cell count of living bacteria in the cultures containing the different Colistin concentrations showed a significant difference between the cultures developed during space flight and the ground based cultures. The comparison between the 1 g and 0 g in-flight cultures show similar behavior for the two sets. Nevertheless, a small difference between the two sets of ground based control cultures was noted. The cultures developed on the ground centrifuge (1.4 g) present a slight decrease in comparison with the cultures developed in the static rack (1 g). In order to approach the mechanisms of the increase of antibiotic resistance on bacteria cultivated in vitro in space, we have proposed the study on penetration of antibiotics in bacterial cells in space conditions. This experiment was selected for the International Microgravity Laboratory 1 (IML-1) mission. Author

**N92-23621\*#** British Columbia Univ., Vancouver.

**PHASE PARTITIONING EXPERIMENT (8-IML-1)**

DONALD E. BROOKS In NASA. Marshall Space Flight Center, First International Microgravity Laboratory Experiment Descriptions p 113-116 Feb. 1992

Avail: NTIS HC/MF A13 CSCL 06C

Phase partitioning is a method of separating biological cells and macromolecules via their differential distribution in two phase aqueous polymer solutions. The ultimate goal of the experiment is to test the hypothesis that the efficiency of separation of closely related cell types, by partitioning in immiscible aqueous phases, will be enhanced in the non-convective environment provided by space. Before a cell separation experiment can be performed, the demixing of immiscible aqueous polymer solutions must be understood and controlled in order to optimize the experimental conditions for a cell separation experiment in the future. The present Phase Partitioning Experiment (PPE) is the third in a series, the first two flew on STS 51-D in Apr. 1985 and STS 26 in Oct. 1988. In those experiments the immiscible aqueous phases demixed spontaneously at different rates, the final disposition being one in which the phase which wetted the container wall surrounded the second phase which formed an 'egg yolk' in the center of the chamber. D.R.D.

**N92-23629\*#** National Space Development Agency, Tokyo (Japan).

**RADIATION MONITORING CONTAINER DEVICE (16-IML-1)**

S. NAGAOKA In NASA. Marshall Space Flight Center, First International Microgravity Laboratory Experiment Descriptions p 189 Feb. 1992

Avail: NTIS HC/MF A13 CSCL 06C

In this experiment, layers of radiation detectors and biological specimens, bacterial spores (*Bacillus subtilis*), shrimp eggs (*Artemia salina*), and maize seeds (*Zea mays*) are sandwiched together in the Radiation Monitoring Container. The detectors, sheets of plastic materials, record the nuclear track of cosmic radiation. The dosimeter package contains conventional detectors made of materials such as lithium fluoride or magnesium-silica-terbium. The thermoluminescent materials (TLD) will, when moderately heated, emit luminescent photons linearly depending upon the dose of radiation received. The experiment, enclosed in a box-like container, is mounted on the aft end cone of the Spacelab, the area where the shielding is somewhat less than other locations. Author

**N92-23653\*#** Genetech, Inc., San Francisco, CA. Endocrine Research Div.

**CENTER FOR CELL RESEARCH, PENNSYLVANIA STATE UNIVERSITY**

MIKE CRONIN In NASA, Washington, Proceedings of the Second Annual Symposium on Industrial Involvement and Successes in Commercial Space 11 p 1991

Avail: NTIS HC/MF A11 CSCL 10B

A brief review of Genentech, Inc., is presented. Additionally, the Physiological Systems Experiment (PSE-01) is discussed in terms of its development history. The PSE-01 was developed to investigate the bone wasting, muscle wasting, and immune cell dysfunction that occur in microgravity conditions. Specifically, a number of human disorders are associated with maladaptive changes in bone, muscle, and immune function. The physiological adjustments that the body makes in response to space flight can be monitored and may aid in the discovery of new protein forms and patterns. This research may also provide strategies for protecting the health of flight crews enduring prolonged space flight. Results are discussed. D.R.D.

**N92-23706#** Joint Publications Research Service, Arlington, VA.

**JPRS REPORT: SCIENCE AND TECHNOLOGY. CENTRAL**

**EURASIA: LIFE SCIENCES**

26 Mar. 1992 46 p Transl. into ENGLISH from various Russian articles

(JPRS-ULS-92-010) Avail: NTIS HC/MF A03

A bibliography is given of Central Eurasian research in life sciences. Topics covered include biochemistry, biophysics, biotechnology, the Earth environment, radiation effects, genetics, immunology, clinical medicine, microbiology, pharmacology, toxicology, physiology, public health, psychology, radiation biology, veterinary medicine, and virology. Author

**N92-24052\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

**THREE-DIMENSIONAL CULTURED GLIOMA CELL LINES**

**Patent Application**

STEVE R. GONDA, inventor (to NASA) and GARRY M. MARLEY, inventor (to NASA) (Krug International, Houston, TX.) 9 Dec. 1991 28 p

(NASA-CASE-MS-21843-1-NP; NAS 1.71:MSC-21843-1-NP; US-PATENT-APPL-SN-803828) Avail: NTIS HC/MF A03 CSCL 06C

Three-dimensional glioma spheroids were produced in vitro with size and histological differentiation previously unattained. The spheroids were grown in liquid media suspension in a Johnson Space Center (JSC) Rotating Wall Bioreactor without using support matrices such as microcarrier beads. Spheroid volumes of greater than 3.5 cu mm and diameters of 2.5 mm were achieved with a viable external layer or rim of proliferating cells, a transitional layer beneath the external layer with histological differentiation, and a degenerative central region with a hypoxic necrotic core. Cell debris was evident in the degenerative central region. The necrotic centers of some of the spheroids had hyaline droplets. Granular bodies were detected predominantly in the necrotic center. NASA

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### AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

**A92-32991**

**TAKING THE BLINDERS OFF SPATIAL DISORIENTATION**

ROBERT A. G. MONTGOMERY, JR. (AeroMedical Training Institute, Southampton, PA), JOHN C. PATTERSON (USAF, School of Aerospace Medicine, Brooks AFB, TX), and KYLE D. G. MONTGOMERY (AeroMedical Training Institute, Southampton, PA) IN: Annual SAFE Symposium, 28th, San Antonio, TX, Dec. 11-13, 1990, Proceedings. Newhall, CA, SAFE Association, 1991,

p. 144-148. refs

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Spatial disorientation (SD) is examined in the light of the evolution of knowledge of SD, existing definitions of the concept, and potential training methods. Definitions are given for significant SD concepts including unrecognized (type-I), recognized (type-II), and incapacitating (type-III) disorientation classes. The majority of disorientation mishaps are associated with type-I disorientation, and cognitive processing is discussed to describe the phenomena associated with this type of disorientation. Flight and task conditions are key factors, and the use of the attitude directional indicator can be interrupted by high task loads. The main problem leading to disorientation is the pilot's use of subconscious inputs to control the aircraft. Knowledge regarding mental-processing issues such as channelized attention, task saturation, and habituation are therefore vital to the understanding of type-I SD. C.C.S.

**A92-34191****THE EFFECTS OF PROLONGED SPACEFLIGHTS ON THE HUMAN BODY**

ANATOLII I. GRIGOR'EV and ANATOLII D. EGOROV (Institute of Biomedical Problems, Moscow, Russia) IN: *Advances in space biology and medicine*. Vol. 1. Greenwich, CT, JAI Press, Inc., 1991, p. 1-35. refs

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The components and major factors of the mechanisms responsible for physiological changes in human body due to the effects of microgravity in space are examined. Special attention is given to the effect of a prolonged spaceflight on the vestibular system, the motor and skeletal systems, the cardiovascular system, the endocrine and metabolic system, the blood components, and the immune system. Results of medical investigations of long-term missions showed that humans can adequately adapt and work efficiently in space for as long as a year. Good health condition and adequate work capacity may be enhanced by various measures, such as various countermeasures to the adverse effects of microgravity, a comfortable environment, sufficient sleep and rational work-rest cycles, a well-balanced nutrition, and a proper selection of crews. I.S.

**A92-34254****THROUGH THE CANOPY GLASS - A COMPARISON OF INJURIES IN NAVAL AVIATION EJECTIONS THROUGH THE CANOPY AND AFTER CANOPY JETTISON, 1977 TO 1990**

D. W. YACAVONE, R. BASON, and M. S. BOROWSKY (U.S. Navy, Naval Safety Center, Norfolk, VA) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 63, April 1992, p. 262-266. refs

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Two methods of ejection from tactical aircraft are commonly used: jettisoning the canopy prior to seat travel, and ejecting through a closed canopy. This report compares the ejection injury experience of Naval Aviation in each mode during January 1977-August 1990. During that period, 336 through-canopy and 580 canopy-jettison ejections were accomplished. The former group sustained 10.7 percent fatal injuries, and only 17.0 percent egressed injury-free. By comparison, the latter cohort incurred only 4.7 percent fatalities and fully 31.9 percent egressed without injury. Analysis of patterns of injuries confirms higher G-forces in through-canopy ejections, resulting in not only more injuries, but more severe injuries. In spite of these findings, the compelling tactical and financial reasons to consider through-canopy systems are discussed. Author

**A92-34255****LIMB BLOOD FLOW WHILE WEARING AIRCREW CHEMICAL DEFENSE ENSEMBLES IN THE HEAT WITH AND WITHOUT AUXILIARY COOLING**

B. BAIN and A. L. VALLERAND (Defence and Civil Institute of Environmental Medicine, North York, Canada) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 63, April 1992, p. 267-272. refs

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The effect of auxiliary air cooling on endurance time and limb blood flow in the heat (37 C, 50 percent r.h., target time = 150 min) while wearing aircrew chemical defense (CD) ensembles was examined. Eight males were dressed in aircrew CD ensembles with or without an air-cooled vest. After an initial 10 min treadmill walk and 20 min of seated rest, the subjects alternately rested and exercised on a cycle ergometer (10 min rest, 10 min exercise) resulting in an overall metabolic rate of 240 W. Arm and leg blood flow, determined by venous occlusion plethysmography, were significantly lower with air cooling (AC) than with no cooling (NC) during the same time period (p less than 0.05). Endurance time was much greater with AC than with NC (150 min AC vs 92 +/- 0.08 min NC, p less than 0.01). Arm and calf skin temperatures, rectal temperature and heart rate were all significantly lower with AC than with NC (p less than 0.05) after the onset of the cycle exercise. The results show that the use of the air-cooled vest under these conditions was able to increase heat tolerance and reduce blood flow to the periphery. Author

**A92-34256****EYEGLASS USE BY U.S. NAVY JET PILOTS - EFFECTS ON NIGHT CARRIER LANDING PERFORMANCE**

DAVID L. STILL and LEONARD A. TEMME (U.S. Navy, Naval Air Station, Pensacola, FL) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 63, April 1992, p. 273-275. Research supported by U.S. Navy. refs

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The purpose of this study was to test the hypothesis that the night carrier landing performance of pilots who do not need prescriptive eyeglasses to fly is better than the performance of pilots who do. Night carrier landing scores (NCLS), age, career jet flight hours, and total career flight hours were obtained for 122 U.S. Navy fighter pilots participating in air combat maneuver training at NAS, Oceana, VA. Of the pilots with NCLS, 16 used a prescribed spectacle correction while flying, 106 did not. This study compared the NCLS of the two groups of pilots, those with glasses and those without. No significant difference in NCLS between the two groups of pilots-even when the pilots were matched on the basis of age and flight experience was found. It is concluded that pilots who have a refractive error and are required to wear an eyeglass correction while flying perform night carrier landings as well as the pilots who have no refractive error and are permitted to fly with no eye glass correction. Author

**A92-34257****THE MORTALITY OF BRITISH AIRWAYS PILOTS, 1966-1989 - A PROPORTIONAL MORTALITY STUDY**

DAVID IRVINE and D. M. DAVIES (British Airways, PLC, London, England) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 63, April 1992, p. 276-279. Research supported by Civil Aviation Authority. refs

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Of 446 deaths among serving and retired British Airways pilots between 1966 and 1989, 411 were analyzed using the Proportional Mortality Ratio (PMR) technique. After removal of the predictable excess of aircraft accidents, excesses of cancer (PMR 1.31) and other accidents (1.60) were balanced by deficits in diseases of the circulatory (0.83) and respiratory (0.49) systems. While lung cancer was close to expectation (1.10), consistent excesses were shown in all analyses for malignant melanoma (6.68), cirrhosis of the liver (2.88), colon cancer (2.30) and brain/CNS cancer (2.68). Consideration of these ratios in relation to pilots' lifestyle and occupation leads to the conclusion that the brain/CNS cancer excess must be studied further. Author

**A92-34260****INTRAVENTRICULAR CONDUCTION DISTURBANCES IN CIVILIAN FLYING PERSONNEL - LEFT ANTERIOR HEMIBLOCK**

GERARDO CANAVERIS (Instituto Nacional de Medicina Aeronautica y Espacial, Buenos Aires, Argentina), M. S. HALPERN, and MARCELO V. ELIZARI (Ramos Mejia Hospital, Buenos Aires,

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Argentina) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 63, April 1992, p. 292-298. refs  
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A retrospective study of the natural history, clinical significance, prognosis, associated conduction disturbances, and pathology, as well as flying fitness qualification of 247 cases of left anterior hemiblock (LAH), detected in a presumably healthy population of 8915 male individuals engaged in civilian flying activities (prevalence: 2.77 percent). The cases were divided into three groups according to the electrical axis value of the first electrocardiogram (ECG). The group with the slow mode of appearance of LAH was the most common. If associated with right bundle branch block, LAH usually evolves first. LAH could not be ascribed to any definite pathology; neither was it a forerunner of left bundle branch block nor complete atrioventricular block. Not one episode of syncope nor of sudden incapacitation was reported. As a mere ECG finding, LAH does not modify an aviator's fitness qualification. If another conduction disturbance develops, qualification will depend on the results of complementary studies, noninvasive or invasive, according to any associated conduction disturbance. Author

**A92-34261**

### **THE INCIDENCE OF MYOPIA IN THE ISRAEL AIR FORCE RATED POPULATION - A 10-YEAR PROSPECTIVE STUDY**

PAUL FROOM, YORAM BIGER, JACOB EREL, BENJAMIN DAVIDSON, and IGAL SHOCHAT (Israeli Air Force, Aeromedical Center, Ramat Gan, Israel) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 63, April 1992, p. 299-301. refs  
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It is important to define the risk in pilots of becoming myopic in order to determine the need for yearly screening, and to predict pilot eligibility in environments where the use of corrective lenses may present problems. A prospective study of 1400 Air Force personnel followed for 10 years, who could be divided into three major groups; those with 20/20 vision in both eyes, those with 20/25 in one eye only and whose vision was 20/20 using both eyes together, and those who were accepted despite the fact that they required corrective lenses was conducted. Over the 10-year period, 23.1 percent of those with 20/25 visual acuity in one eye needed corrective lenses, significantly more than the 7.4 percent observed in those with 20/20 vision in both eyes (relative risk 3.1, 95 percent confidence interval 2.2-4.3, p less than 0.0000). The prevalence of corrective lenses increased until age 26. It is concluded that 7.4 percent of pilots will become myopic over a 10-year period if accepted with 20/20 vision in both eyes. The risk, however, is much higher in those with incipient growth myopia starting in one eye at entry. Therefore, the annual screening of visual acuity in air force personnel is essential. Author

**A92-34262**

### **CATARACT SURGERY AND INTRAOCULAR LENSES IN MILITARY AVIATORS**

DEBRA L. MOORMAN and ROBERT P. GREEN, JR. (USAF, Armstrong Laboratory, Brooks AFB, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 63, April 1992, p. 302-307. refs  
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The medical records of 23 military aviators who were evaluated by the United States Air Force School of Aerospace Medicine after cataract extraction with intraocular lens implantation between 1979 and 1990 were reviewed. The 23 subjects were male Caucasians, with a mean age of 43 years. Of the subjects, 21 were pilots, and, of these, 8 were qualified in high-performance aircraft. There were a total of 28 operated eyes, 24 of which had received extracapsular cataract extractions (ECCE) with posterior chamber lenses. The best-corrected, postoperative vision was 20/20 or better in all eyes. Posterior capsule opacification occurred in 14 (60 percent) of the ECCE eyes, with five requiring Nd: Yttrium-aluminum-garnet laser capsulotomies. One aviator was disqualified from flying duties because of ocular deficiencies, for a visually-qualified-to-fly rate of 96 percent. Eight aviators have

actually flown since surgery. Although follow-up was short, the initial results are encouraging. Author

**A92-34263**

### **THE REVISED TRAUMA SCORE - A MEANS TO EVALUATE AEROMEDICAL STAFFING PATTERNS**

HOWARD RODENBERG (Florida, University, Gainesville) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 63, April 1992, p. 308-313. refs  
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The myriad of crew configurations used in the transport of patients by aeromedical services have not been subject to objective measures of patient status before and after transport as a means of evaluating their contribution to patient care. This work reviews the outcomes of 96 patients cared for by aeromedical crews composed of two dual-licensed registered nurse (RN)/paramedics (PM) or one registered nurse and one paramedic. The revised trauma score for triage (RTS) was used as an objective measure of patient status. There were no significant differences between the crew configurations in ground time, flight time, total mission time, and RTS after transport; initial RTS in patients cared for by 2 RN/PM crews was significantly lower. Analysis of the subset of patients felt to be more severely injured (RTS equal to or less than 10) failed to show any significant differences between these two groups. This work outlines a methodology that objectively assesses the contribution of different crew configurations to the care of the trauma patient. Author

**A92-34264**

### **SIMULTANEOUS USE OF RHEOENCEPHALOGRAPHY AND ELECTROENCEPHALOGRAPHY FOR THE MONITORING OF CEREBRAL FUNCTION**

L. D. MONTGOMERY (LDM Associates, San Jose, CA) and C. R. GLEASON (California, University, San Francisco) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 63, April 1992, p. 314-321. Research supported by SRI International. refs  
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Many of the changes in human performance under stress or in hazardous environments may be attributed, in part, to altered cerebral functions. These changes may take place in either the cerebral neurologic or cerebral circulatory systems. Investigation of the interaction between intracranial blood flow and neural activity during these exposures would provide a better understanding of the human response to these conditions. Experimental and analytical procedures are described whereby the combination of rheoencephalography (REG) and electroencephalography (EEG) may provide additional information during the study of cerebral function. Examples are given to demonstrate the simultaneous use of these techniques during mental arithmetic and antihypertensive bed rest. Results of these tests in both the time and frequency domains show that REG and EEG can be used to provide graded quantitative measures of cerebral responses to externally applied stressors. Author

**A92-35351\*** National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.

### **SKELETAL MUSCLE RESPONSES TO LOWER LIMB SUSPENSION IN HUMANS**

BRUCE M. HATHER, GREGORY R. ADAMS, PER A. TESCH, and GARY A. DUDLEY (NASA, Kennedy Space Center; Bionetics Corp., Cocoa Beach; Holmes Regional Medical Center, Melbourne, FL; Karolinska Institutet, Stockholm, Sweden) Journal of Applied Physiology (ISSN 8750-7587), vol. 72, no. 4, April 1992, p. 1493-1498. Research supported by Swedish Central Association for the Promotion of Sports. refs  
(Contract NAS10-11624)  
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The morphological responses of human skeletal muscle to unweighting were assessed by analyzing multiple transaxial magnetic resonance (MR) images of both lower limbs and skeletal muscle biopsies of the unweighted lower limb before and after six weeks of unilateral (left) lower limb suspension (ULLS). Results indicated that, as a results of 6 weeks of unweighting (by the



subjects walking on crutches using only one limb), the cross sectional area (CSA) of the thigh muscle of the unweighted left limb decreased 12 percent, while the CSA of the right thigh muscle did not change. The decrease was due to a twofold greater response of the knee extensors than the knee flexors. The pre- and post-ULLS biopsies of the left vastus lateralis showed a 14 percent decrease in average fiber CSA due to unweighting. The number of capillaries surrounding the different fiber types was unchanged after ULLS. Results showed that the adaptive responses of human skeletal muscle to unweighting are qualitatively, but not quantitatively, similar to those of lower mammals and not necessarily dependent on the fiber-type composition. I.S.

#### A92-35353

##### **PREDICTING THE TIME OF OCCURRENCE OF DECOMPRESSION SICKNESS**

P. K. WEATHERSBY, S. S. SURVANSI, L. D. HOMER, E. PARKER, and E. D. THALMANN (U.S. Navy, Naval Submarine Medical Research Laboratory, Groton, CT; U.S. Navy, Naval Medical Research Institute, Bethesda, MD) *Journal of Applied Physiology* (ISSN 8750-7587), vol. 72, no. 4, April 1992, p. 1541-1548. Research supported by U.S. Navy. refs  
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The feasibility of predicting the time of the occurrence of decompression sickness (DCS) was investigated using probabilistic models and maximum likelihood estimation. Two models were compared in fitting a data set of nearly 1000 exposures, in which more than 50 cases of DCS had known times of symptom onset. This information on the time at which DCS occurred allowed better estimates of model parameters. It was possible to discriminate between good models, which predict both the occurrence of DCS and the time at which symptoms occur, and poorer models, which may predict only the overall occurrence. I.S.

#### A92-35430

##### **VENOUS GAS EMBOLI DETECTION AND ENDPOINTS FOR DECOMPRESSION SICKNESS RESEARCH**

JAMES T. WEBB (Krug Life Sciences, Inc., San Antonio, TX) and ANDREW A. PILMANIS (USAF, Armstrong Aerospace Medical Research Laboratory, Brooks AFB, TX) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 20-23. refs  
(Contract F33615-89-C-0603)  
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The use of precordial Doppler ultrasound detection of venous gas emboli (VGE) to estimate the probability of developing decompression sickness (DCS) is reviewed. Analysis of hypobaric DCS data revealed that use of VGE to predict DCS would have been correct only about 65 percent of the time. Results from the use of VGE have not proven to be reliable in predicting DCS and, therefore, instead of VGE detection as an abort criterion, symptoms are used as endpoints in DCS studies. A conversion scale is proposed which is based on pain and quantification of impairment in function or performance as evaluated with performance assessment battery results. O.G.

#### A92-35455

##### **THE PHYSIOLOGICAL REQUIREMENT ON THE CONCENTRATION OF AIRCRAFTS' OXYGEN SUPPLY EQUIPMENT**

HUA-JUN XIAO, YU-MING ZHANG, and DENG-YAN HE (Institute of Aviation Medicine, Beijing, People's Republic of China) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 192-194. refs

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Eight subjects had inspired oxygen concentrations from 50 to 100 percent for 5 min and then exposed to 16,000 m equally for 15 sec. The results show that as long as the concentration of oxygen inspiring was above 70 percent, the alveolar oxygen partial pressure was above 4.0 KPa (30 mmHg) and no hypoxia symptoms occurred during the test. The preliminary experiment shows oxygen concentrations above 70 percent may not only prevent from severe

transient hypoxia, but also avoid affecting the pilots' lungs due to using pure oxygen in fly. Thus, concentration should be adjusted to moderate range and the human factors should be considered in human engineering interface. Author

#### A92-35630

##### **EVALUATION OF TEMPERATURE ADAPTATION IN THE SPACE ENVIRONMENT**

T. KAKI and AKIRA MASUMOTO (Kawasaki Heavy Industries, Ltd., Akashi, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 61, 62. In Japanese. refs

Evaluation methods for temperature adaptation are presented. The concept of the thermal balance of the human body is discussed. Y.P.Q.

#### A92-35843

##### **BIOMEDICAL SCIENCES INSTRUMENTATION. VOL. 28 - TECHNICAL PAPERS COMPOSING THE PROCEEDINGS OF THE 29TH ANNUAL ROCKY MOUNTAIN BIOENGINEERING SYMPOSIUM AND 29TH INTERNATIONAL ISA BIOMEDICAL SCIENCES INSTRUMENTATION SYMPOSIUM**

Research Triangle Park, NC, Instrument Society of America, 1992, 194 p. For individual items see A92-35844 to A92-35846. (ISBN 1-55617-377-6) Copyright

Topics discussed include instrumentation, physiology, current topics, physiological monitoring, drug delivery via biomaterials, physiological models and simulation, and biomaterials. Papers are presented on contractile wire biomechanical actuators, an electronic ECG simulator, selecting a stimulus signal for linear systems analysis of the vestibuloocular reflex, ECG dynamics brain processing of sensory and cognitive information, and intersegmental elbow joint load during pushup. Attention is also given to differential features for a neural-network-based anesthesia alarm system, an automated situational analysis for operating-room anesthesia monitoring, the development of a microcomputer-based system to quantify the effective dose of drug through epithelial cells, mathematical modeling of the postexercise heart-rate recovery in ponies, endothelial vasoactive influence simulated by exponential feedback, and insulin delivery by zinc calcium phosphate ceramics. I.S.

#### A92-35845

##### **COMPARISON OF THE FREQUENCY SPECTRA OF SURFACE ELECTROMYOGRAPHIC SIGNALS FROM THE SOLEUS MUSCLE UNDER NORMAL AND ALTERED SENSORY ENVIRONMENTS**

SHARI J. SCHROEDER, CHARLES S. LAYNE, and RUTH A. DYER (Kansas State University, Manhattan) IN: Biomedical Sciences Instrumentation. Vol. 28. Research Triangle Park, NC, Instrument Society of America, 1992, p. 43-50. refs  
Copyright

This study was designed to observe muscle activation characteristics when a single component of the sensory environment was altered. Partially immersing a subject in a water pool provided a buoyant force upon the lower body, 'unloading' the muscles, similar to the effect on the muscles in weightlessness. Surface EMG from the soleus was obtained during the performance of a constant-force isometric contraction. The mean and median characteristic frequencies were calculated from the power spectrum of each trial. Six of ten subjects showed a difference in the characteristic frequencies between the two environments. It appears that for some individuals there are changes in muscle activation characteristics due to influences of the proprioceptive system when exposed to an altered sensory environment. Author

#### A92-35846

##### **NUMERICAL STUDY OF ARTERIAL FLOW DURING SUSTAINED EXTERNAL ACCELERATION**

D. A. CORNET, D. F. YOUNG, and T. R. ROGGE (Iowa State University of Science and Technology, Ames) IN: Biomedical

Sciences Instrumentation. Vol. 28. Research Triangle Park, NC, Instrument Society of America, 1992, p. 135-143. refs  
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A computer model of the human arterial tree based upon the one-dimensional flow equations is used to study the effects of sustained acceleration on eye-level arterial pressure and flow. Steady-state physiological compensatory mechanisms are modeled using human centrifuge data found in the literature. Cases investigated include the supine and standing human the application of resistive and occlusive anti-G suits, and the occurrence of a stenosis proximal to the carotid bifurcation. Results indicate that the simulated eye-level pressures and flows satisfactorily correspond with those found in the literature. Author

#### A92-36415

#### CIRCADIAN RHYTHMS OF BLOOD LEVELS OF LIPIDS AND HORMONES IN PILOTS [TSIRKADIANNYI RITM UROVNIYA LIPIDOV I GORMONOV V KROVI LETCHIKOV]

E. E. NIKOLAEVSKII Voenno-Meditsinskii Zhurnal (ISSN 0026-9050), no. 1, Jan. 1992, p. 61-64. In Russian. refs  
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The effect of atherosclerosis on circadian rhythms of blood levels of lipids and hormones in humans was investigated using, as subjects, physically healthy pilots and two groups of pilots diagnosed to be in various stages of atherosclerosis: (1) subjects exhibiting clinical signs of aortic atherosclerosis, and (2) subjects with diagnosed ischemic heart disease. Results of clinical analyses of blood cholesterol, triglycerides, total lipids, beta-lipoproteins, cortisol, aldosterone, and testosterone disclosed significant differences in the character of circadian rhythms of these lipid and hormonal indices among the three groups. Subjects with atherosclerotic symptoms exhibited various levels of desynchronization. Subjects who exhibited only symptoms of aortic atherosclerosis showed increases of basal indices, increased rhythm amplitudes, and moderate shifts in some rhythms. Subjects with heart ischemia exhibited more significant desynchronization, lower amplitudes of hormonal rhythm, compared with controls, and significant shifts in the lipid, cortisol, aldosterone, and testosterone acrophases. I.S.

**N92-22127#** Food and Drug Administration, Rockville, MD. Center for Devices and Radiological Health.

#### CLASSIFICATION NAMES FOR MEDICAL DEVICES AND IN VITRO DIAGNOSTIC PRODUCTS

Aug. 1991 270 p  
(PB92-111640; FDA/CDRH-91/35; DHHS/PUB/FDA-91-4246)  
Avail: NTIS HC/MF A12 CSCL 06P

The directory contains product names developed by the Food and Drug Administration (FDA) device classification panels and additional names established by the FDA to support premarket notification and other processes. The directory updates and combines two separate editions of product code directories published in 1977. The product codes contained in the directory are to be used in any submissions to the FDA which require a product code. Each product name is identified by a product code which consists of five digits. The directory also contains the regulation citation to Title 21, Code of Federal Regulations, and the class of the device. The directory is organized by keywords in alphabetical order. Author

**N92-22186\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

#### MULTIPLE LESION TRACK STRUCTURE MODEL

JOHN W. WILSON, FRANCIS A. CUCINOTTA, and JUDY L. SHINN Mar. 1992 14 p Sponsored in part by the Armed Forces Radiobiology Research Institute  
(NASA-TP-3185; L-16988; NAS 1.60:3185) Avail: NTIS HC/MF A03 CSCL 06P

A multilesion cell kinetic model is derived, and radiation kinetic coefficients are related to the Katz track structure model. The repair-related coefficients are determined from the delayed plating experiments of Yang et al. for the C3H10T1/2 cell system. The model agrees well with the x ray and heavy ion experiments of

Yang et al. for the immediate plating, delaying plating, and fractionated exposure protocols employed by Yang. A study is made of the effects of target fragments in energetic proton exposures and of the repair-deficient target-fragment-induced lesions. Author

**N92-22332\*#** Aerospace Medical Research Labs., Brooks AFB, TX. Sustained Operations Branch.

#### THE NEUROCHEMICAL BASIS OF PHOTIC ENTRAINMENT OF THE CIRCADIAN PACEMAKER

MICHAEL A. REA, BECKY BUCKLEY, and LEWIS M. LUTTON (Mercyhurst Coll., Erie, PA.) In NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 476-481 Feb. 1992  
Avail: NTIS HC/MF A17 CSCL 06P

Circadian rhythmicity in mammals is controlled by the action of a light-entrainable hypothalamus, in association with two cell clusters known as the supra chiasmatic nuclei (SCN). In the absence of temporal environmental clues, this pacemaker continues to measure time by an endogenous mechanism (clock), driving biochemical, physiological, and behavioral rhythms that reflect the natural period of the pacemaker oscillation. This endogenous period usually differs slightly from 24 hours (i.e., circadian). When mammals are maintained under a 24 hour light-dark (LD) cycle, the pacemaker becomes entrained such that the period of the pacemaker oscillation matches that of the LD cycle. Potentially entraining photic information is conveyed to the SCN via a direct retinal projection, the retinohypothalamic tract (RHT). RHT neurotransmission is thought to be mediated by the release of excitatory amino acids (EAA) in the SCN. In support of this hypothesis, recent experiments using nocturnal rodents have shown that EAA antagonists block the effects of light on pacemaker-driven behavioral rhythms, and attenuate light induced gene expression in SCN cells. An understanding of the neurochemical basis of the photic entrainment process would facilitate the development of pharmacological strategies for maintaining synchrony among shift workers in environments, such as the Space Station, which provide unreliable or conflicting temporal photic clues. Author

**N92-22333\*#** Aerospace Medical Research Labs., Brooks AFB, TX.

#### PHOTIC EFFECTS ON SUSTAINED PERFORMANCE

J. FRENCH, J. WHITMORE, P. J. HANNON, G. BRAINARD (Jefferson Medical Coll., Philadelphia, PA.), and S. SCHIFLETT In NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 482-486 Feb. 1992 Sponsored by NASA; AF; and DoD  
Avail: NTIS HC/MF A17 CSCL 06P

Research is described which evaluates manipulating environmental light intensity as a means to attenuate fatigue. A counter balanced, within-subjects design was used to compare nine male subjects exposed to dim (100 lux) and bright (3000 lux) light conditions. Oral temperature values were greater for the bright light group over the dim light condition. Melatonin levels were suppressed by bright light treatment. Also, the frequency of eye blink rate was less for subjects during bright over dim light exposure. Light exposure was without effect on subjective fatigue. However, irrespective of light condition, significant effects on confusion, fatigue, and vigor mood dimensions were found as a result of 30 hour sleep deprivation. The findings suggest that bright lights may be used to help sustain nocturnal activity otherwise susceptible to fatigue. Such findings may have implications for the lighting arrangements on space flights during the subjective night for astronauts. Author

**N92-22338\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

#### THE APPLICATION OF INTEGRATED KNOWLEDGE-BASED SYSTEMS FOR THE BIOMEDICAL RISK ASSESSMENT INTELLIGENT NETWORK (BRAIN)

KARIN C. LOFTIN, BEBE LY, LAURIE WEBSTER, JAMES VERLANDER (Krug Life Sciences, Inc., Houston, TX.), GERALD



R. TAYLOR, GARY RILEY, and CHRIS CULBERT *In its* 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 522-528 Feb. 1992  
 Avail: NTIS HC/MF A17 CSCL 06P

One of NASA's goals for long duration space flight is to maintain acceptable levels of crew health, safety, and performance. One way of meeting this goal is through BRAIN, an integrated network of both human and computer elements. BRAIN will function as an advisor to mission managers by assessing the risk of inflight biomedical problems and recommending appropriate countermeasures. Described here is a joint effort among various NASA elements to develop BRAIN and the Infectious Disease Risk Assessment (IDRA) prototype. The implementation of this effort addresses the technological aspects of knowledge acquisition, integration of IDRA components, the use of expert systems to automate the biomedical prediction process, development of a user friendly interface, and integration of IDRA and ExerCISys systems. Because C language, CLIPS and the X-Window System are portable and easily integrated, they were chosen as the tools for the initial IDRA prototype. Author

**N92-22350\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

**SPACE SICKNESS PREDICTORS SUGGEST FLUID SHIFT INVOLVEMENT AND POSSIBLE COUNTERMEASURES**

K. E. SIMANONOK, E. C. MOSELEY, and J. B. CHARLES *In its* 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 595-604 Feb. 1992  
 Avail: NTIS HC/MF A17 CSCL 06P

Preflight data from 64 first time Shuttle crew members were examined retrospectively to predict space sickness severity (NONE, MILD, MODERATE, or SEVERE) by discriminant analysis. From 9 input variables relating to fluid, electrolyte, and cardiovascular status, 8 variables were chosen by discriminant analysis that correctly predicted space sickness severity with 59 pct. success by one method of cross validation on the original sample and 67 pct. by another method. The 8 variables in order of their importance for predicting space sickness severity are sitting systolic blood pressure, serum uric acid, calculated blood volume, serum phosphate, urine osmolality, environmental temperature at the launch site, red cell count, and serum chloride. These results suggest the presence of predisposing physiologic factors to space sickness that implicate a fluid shift etiology. Addition of a 10th input variable, hours spent in the Weightless Environment Training Facility (WETF), improved the prediction of space sickness severity to 66 pct. success by the first method of cross validation on the original sample and to 71 pct. by the second method. The data suggest that WETF training may reduce space sickness severity. Author

**N92-22351\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

**COMPUTER SIMULATION OF PREFLIGHT BLOOD VOLUME REDUCTION AS A COUNTERMEASURE TO FLUID SHIFTS IN SPACE FLIGHT**

K. E. SIMANONOK, R. SRINIVASAN, and J. B. CHARLES *In its* 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 605-608 Feb. 1992  
 Avail: NTIS HC/MF A17 CSCL 06P

Fluid shifts in weightlessness may cause a central volume expansion, activating reflexes to reduce the blood volume. Computer simulation was used to test the hypothesis that preadaptation of the blood volume prior to exposure to weightlessness could counteract the central volume expansion due to fluid shifts and thereby attenuate the circulatory and renal responses resulting in large losses of fluid from body water compartments. The Guyton Model of Fluid, Electrolyte, and Circulatory Regulation was modified to simulate the six degree head down tilt that is frequently used as an experimental analog of weightlessness in bedrest studies. Simulation results show that preadaptation of the blood volume by a procedure resembling a blood donation immediately before head down bedrest is beneficial in damping the physiologic responses to fluid shifts and reducing

body fluid losses. After ten hours of head down tilt, blood volume after preadaptation is higher than control for 20 to 30 days of bedrest. Preadaptation also produces potentially beneficial higher extracellular volume and total body water for 20 to 30 days of bedrest. Author

**N92-22352\*#** Aerospace Medical Research Labs., Brooks AFB, TX. High Altitude Protection Function.

**THE 1990 HYPOBARIC DECOMPRESSION SICKNESS**

**WORKSHOP: SUMMARY AND CONCLUSIONS Abstract Only**

ANDREW A. PILMANIS, BARBARA J. STEGMANN (Krug Life Sciences, Inc., San Antonio, TX.), and TERRELL E. SCOGGINS *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 609 Feb. 1992 Presented at the AGARD 71st Aerospace Medical Panel Symposium, 29 Apr. - 3 May 1991, Pensacola, FL Submitted for publication

Avail: NTIS HC/MF A17 CSCL 06P

Decompression sickness resulting from exposure to the hypobaric environment was reviewed and discussed at a three day workshop in Oct. 1990. This milestone meeting, attended by over 50 participants representing the Dept. of Defense, NASA, ESA, and academia, updated the current understanding of altitude decompression sickness (DCS). Both research and operational aspects of this illness were addressed through presentations on the pathophysiology and clinical manifestations of DCS, its incidence in aviation and space operations, and existing and proposed measures for DCS prevention. Specific areas requiring further research were also identified. A summary is presented for the material given at the workshop. Author

**N92-22353\*#** Krug Life Sciences, Inc., San Antonio, TX.

**IMPROVING SURVIVAL AFTER TISSUE VAPORIZATION**

**(EBULLISM) Abstract Only**

BARBARA J. STEGMANN, ANDREW A. PILMANIS, and TONIANN DERION (Aerospace Medical Research Labs., Brooks AFB, TX.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 610 Feb. 1992

Avail: NTIS HC/MF A17 CSCL 06P

Exposure of unprotected humans to altitudes above 63,000 ft results in ebullism. Ebullism occurs when the vapor pressure of tissues is less than the ambient pressure and the tissues spontaneously 'boil'. This may result in rapid unconsciousness, cardiac vaporlock, pulmonary collapse, cerebral anoxia, and sometimes even death. Potential places for this include EVA accidents in space, aircraft experiencing rapid decompression at high altitudes with cabin or pressure suit failure, and accidents during pressure suit training exercises. The pathophysiology of ebullism was studied in the 40's to 60's using animal models. There is one report of a prolonged, unprotected human exposure and several anecdotal of unprotected short term exposures to near vacuum. In addition to pulmonary and neurologic concerns, unprotected exposure of the head may result in freezing of the corneal surface of the eye. Surface eye freezing may impair vision and significantly impact mission completion. At this time, little data are available on the effectiveness of conventional treatment protocols, such as hyperbaric oxygen, for ebullism induced injuries. Research is needed to assess the efficacy of other adjunctive therapies such as high frequency ventilation and cerebral protective drugs that are still under development. Author

**N92-22355\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

**HUMAN EXPOSURE LIMITS TO HYPERGOLIC FUELS**

H. D. GARCIA, J. T. JAMES, and T. F. LIMERO (Krug Life Sciences, Inc., Houston, TX.) *In its* 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 620-626 Feb. 1992

Avail: NTIS HC/MF A17 CSCL 06P

Over the past four decades, many studies have been conducted on the toxicities of the rocket propellants hydrazine (HZ) and monomethylhydrazine (MH). Numerous technical challenges have

made it difficult to unambiguously interpret the results of these studies, and there is considerable divergence between results obtained by different investigators on the inhalation concentrations (MAC's) for each toxic effect inducible by exposure to hypergolic fuels in spacecraft atmospheres, NASA undertook a critical review of published and unpublished investigations on the toxicities of these compounds. The current state of the art practices for similar studies. While many questions remain unanswered, MAC's were determined using the best available data for a variety of toxic endpoints for potential continuous exposure durations ranging from 1 hour to 180 days. Spacecraft MAC's (SMAC's) were set for each compound based on the most sensitive toxic endpoint at each exposure duration. Author

**N92-22356\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

#### HYDRAZINE MONITORING IN SPACECRAFT

J. H. CROSS, S. W. BECK, T. F. LIMERO (Krug Life Sciences, Inc., Houston, TX.), and J. T. JAMES /In its 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 627-636 Feb. 1992

Avail: NTIS HC/MF A17 CSCL 06P

Hydrazine (HZ) and monomethyl hydrazine (MMH) are highly toxic compounds used as fuels in the Space Shuttle Orbiter Main Engines and in its maneuvering and reaction control system. Satellite refueling during a mission may also result in release of hydrazines. During extravehicular activities, the potential exists for hydrazines to contaminate the suit and to be brought into the internal atmosphere inadvertently. Because of the high toxicity of hydrazines, a very sensitive, reliable, interference-free, and real-time method of measurement is required. A portable ion mobility spectrometer (IMS) has exhibited a low ppb detection limit for hydrazines suggesting a promising technology for the detection of hydrazines in spacecraft air. The Hydrazine Monitor is a modified airborne vapor monitor (AVM) with a custom-built datalogger. This off-the-shelf IMS was developed for the detection of chemical warfare agents on the battlefield. After early evaluations of the AVM for hydrazine measurements showed a serious interference from ammonia, the AVM was modified to measure HZ and MMH in the ppb concentration range without interference from ammonia in the low ppm range. A description of the Hydrazine Monitor and how it functions is presented. Author

**N92-22357\*#** Aerospace Medical Research Labs., Wright-Patterson AFB, OH. Toxic Hazards Div.

#### COMPARISON OF DERMAL AND INHALATION ROUTES OF ENTRY FOR ORGANIC CHEMICALS

GARY W. JEPSON, JAMES N. MCDOUGAL, and HARVEY J. CLEWELL, III /In NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 637-638 Feb. 1992

Avail: NTIS HC/MF A17 CSCL 06P

The quantitative comparison of the chemical concentration inside the body as the result of a dermal exposure versus an inhalation exposure is useful for assessing human health risks and deciding on an appropriate protective posture. In order to describe the relationship between dermal and inhalation routes of exposure, a variety of organic chemicals were evaluated. The types of chemicals chosen for the study were halogenated hydrocarbons, aromatic compounds, non-polar hydrocarbons and inhalation anesthetics. Both dermal and inhalation exposures were conducted in rats and the chemicals were in the form of vapors. Prior to the dermal exposure, rat fur was closely clipped and during the exposure rats were provided fresh breathing air through latex masks. Blood samples were taken during 4-hour exposures and analyzed for the chemical of interest. A physiologically based pharmacokinetic model was used to predict permeability constants (cm/hr) consistent with the observed blood concentrations of the chemical. The ratio of dermal exposure to inhalation exposure required to achieve the same internal dose of chemical was calculated for each test chemical. The calculated ratio in humans ranged from 18 for styrene to 1180 for isoflurane. This methodology can be used to estimate the dermal exposure required to reach

the internal dose achieved by a specific inhalation exposure. Such extrapolation is important since allowable exposure standards are often set for inhalation exposures, but occupational exposures may be dermal. Author

**N92-22358\*#** Aerospace Medical Research Labs., Wright-Patterson AFB, OH.

#### OCCUPATIONAL SAFETY CONSIDERATIONS WITH

##### HYDRAZINE Abstract Only

HARVEY J. CLEWELL, III, JAMES N. MCDOUGAL, MARILYN E. GEORGE, and MELVIN E. ANDERSEN /In NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 639 Feb. 1992

Avail: NTIS HC/MF A17 CSCL 06P

Hydrazine is a reducing agent that is most commonly used as a propellant and as an oxygen scavenger in boilers. Hydrazine is extremely irritating and has been demonstrated to produce both acute and chronic toxicity. As a result, the established permissible inhalation exposure limits are very low, and respiration protection is required whenever vapors are present. Liquid hydrazine penetrates the skin and produces a chemical burn; therefore, some protective measures must also be taken to protect the skin from liquid contact. Often, however, a cumbersome, whole-body protective suit is worn to protect against skin contact with vapor as well. To what extent it is actually necessary to protect skin from vapor penetration had not previously been demonstrated. In an attempt to answer this question, we conducted a study with rats to compare the dermal penetration of hydrazine vapor with inhalation. Pharmacokinetic modeling was used to compare body burdens resulting from these different routes of exposure. The analysis concluded that the vapor concentration during a skin-only exposure would have to be at least 200 times higher than that during inhalation to achieve the same body burden. This type of estimation illustrates the use of predictive toxicology in occupational exposures. Author

**N92-22428\*#** National Cancer Inst., Bethesda, MD. Office of Technology Development.

#### COOPERATIVE RESEARCH AND DEVELOPMENT

##### OPPORTUNITIES WITH THE NATIONAL CANCER INSTITUTE

KATHLEEN SYBERT /In NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 p 39-46 Dec. 1991

Avail: NTIS HC/MF A23 CSCL 06P

The Office of Technology Development (OTD) of the National Cancer Institute (NCI) is responsible for negotiating Cooperative Research and Development Agreements (CRADAs), whereby the knowledge resulting from NCI investigators' government-sponsored research is developed in collaboration with universities and/or industry into new products of importance for the diagnosis and treatment of cancer and acquired immunodeficiency syndrome (AIDS). The NCI has recently executed a unique 'clinical trials' CRADA and is developing a model agreement based upon it for the development and commercialization of products for the diagnosis and treatment of cancer and AIDS. NCI drug screening, preclinical testing, clinical trials, and AIDS program capabilities form the basis for this new technology development/technology transfer vehicle. NCI's extensive drug screening program and 'designer foods' program serve as potential sources of investigational new drugs (INDs) and cancer preventatives. Collaborations between NCI and pharmaceutical companies having the facilities, experience, and expertise necessary to develop INDs into approved drugs available to the public are being encouraged where the companies have proprietary rights to INDs, or where NCI has proprietary rights to INDs and invites companies to respond to a collaborator announcement published in the Federal Register. The joint efforts of the NCI and the chosen collaborator are designed to generate the data necessary to obtain pharmaceutical regulatory approval from the Food and Drug Administration (FDA) to market the drugs developed, and thereby make them available to health care providers for the diagnosis and treatment of cancer and AIDS. Author

**N92-22429\*#** Centers for Disease Control, Atlanta, GA. Technology Transfer Office.

**TECHNOLOGIES FOR THE MARKETPLACE FROM THE CENTERS FOR DISEASE CONTROL**

FRANCES L. REID-SANDEN, R. ERIC GREENE, and DOLORES M. MALVITZ / In NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 p 47-50 Dec. 1991

Avail: NTIS HC/MF A23 CSCL 06P

The Centers for Disease Control, a Public Health Service agency, is responsible for the prevention and control of disease and injury. Programs range from surveillance and prevention of chronic and infectious diseases to occupational health and injury control. These programs have produced technologies in a variety of fields, including vaccine development, new methods of disease diagnosis, and new tools to ensure a safer work environment.

Author

**N92-22464\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**COMPUTATION OF INCOMPRESSIBLE VISCOUS FLOWS THROUGH ARTIFICIAL HEART DEVICES WITH MOVING BOUNDARIES**

CETIN KIRIS, STUART ROGERS, DOCHAN KWAK, and I-DEE CHANG (Stanford Univ., CA.) / In NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 p 351-358 Dec. 1991

Avail: NTIS HC/MF A23 CSCL 06A

The extension of computational fluid dynamics techniques to artificial heart flow simulations is illustrated. Unsteady incompressible Navier-Stokes equations written in 3-D generalized curvilinear coordinates are solved iteratively at each physical time step until the incompressibility condition is satisfied. The solution method is based on the pseudo compressibility approach and uses an implicit upwind differencing scheme together with the Gauss-Seidel line relaxation method. The efficiency and robustness of the time accurate formulation of the algorithm are tested by computing the flow through model geometries. A channel flow with a moving indentation is computed and validated with experimental measurements and other numerical solutions. In order to handle the geometric complexity and the moving boundary problems, a zonal method and an overlapping grid embedding scheme are used, respectively. Steady state solutions for the flow through a tilting disk heart valve was compared against experimental measurements. Good agreement was obtained. The flow computation during the valve opening and closing is carried out to illustrate the moving boundary capability.

Author

**N92-22699\*#** Agricultural Research Service, Ames, IA. National Soil Tilth Lab.

**NUCLEIC ACID PROBES IN DIAGNOSTIC MEDICINE**

PHILLIP A. OBERRY / In NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 p 197-201 Dec. 1991

Avail: NTIS HC/MF A22 CSCL 06B

The need for improved diagnostic procedures is outlined and variations in probe technology are briefly reviewed. A discussion of the application of probe technology to the diagnosis of disease in animals and humans is presented. A comparison of probe versus nonprobe diagnostics and isotopic versus nonisotopic probes is made and the current state of sequence amplification is described. The current market status of nucleic acid probes is reviewed with respect to their diagnostic application in human and veterinary medicine. Representative product examples are described and information on probes being developed that offer promise as future products is discussed.

Author

**N92-22733\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

**ACOUSTICALLY BASED FETAL HEART RATE MONITOR**

DONALD A. BAKER (Baker Guardian Medical Labs., Spokane, WA.) and ALLAN J. ZUCKERWAR / In NASA, Washington,

Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 p 512-517 Dec. 1991

Avail: NTIS HC/MF A22 CSCL 06B

The acoustically based fetal heart rate monitor permits an expectant mother to perform the fetal Non-Stress Test in her home. The potential market would include the one million U.S. pregnancies per year requiring this type of prenatal surveillance. The monitor uses polyvinylidene fluoride (PVF2) piezoelectric polymer film for the acoustic sensors, which are mounted in a seven-element array on a cummerbund. Evaluation of the sensor output signals utilizes a digital signal processor, which performs a linear prediction routine in real time. Clinical tests reveal that the acoustically based monitor provides Non-Stress Test records which are comparable to those obtained with a commercial ultrasonic transducer.

Author

**N92-22734\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

**SURGICAL FORCE DETECTION PROBE**

PING TCHENG, PAUL ROBERTS, CHARLES SCOTT, and RICHARD PRASS (Eastern Virginia Medical School, Norfolk.) / In NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 p 518-532 Dec. 1991

Avail: NTIS HC/MF A22 CSCL 06B

The development progress of a precision electro-mechanical instrument which allows the detection and documentation of the forces and moment applied to human tissue during surgery (under actual operation room conditions), is reported. The pen-shaped prototype probe which measures 1/2 inch in diameter and 7 inches in length was fabricated using an aerodynamic balance. The aerodynamic balance, a standard wind tunnel force and moment sensing transducer, measures the forces and the moments transmitted through the surgeon's hand to the human tissue during surgery. The prototype probe which was fabricated as a development tool was tested successfully. The final version of the surgical force detection probe will be designed based on additional laboratory tests in order to establish the full scale loads. It is expected that the final product will require a simplified aerodynamic balance with two or three force components and one moment component with lighter full scale loads. A signal conditioner was fabricated to process and display the outputs from the prototype probe. This unit will be interfaced with a PC-based data system to provide automatic data acquisition, data processing, and graphics display. The expected overall accuracy of the probe is better than one percent full scale.

Author

**N92-23071#** Amsterdam Univ. (Netherlands). Dept. of Physiology.

**CONTROL OF BLOOD PRESSURE IN HUMANS UNDER MICROGRAVITY**

J. M. KAREMAKER, E. M. AKKERMAN, M. VANLEEUEWEN, K. H. WESSELMING, J. J. SETTELS, W. WIELING (Academic Medical Center, Amsterdam, Netherlands), and J. H. A. DAMBRINK / In Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands p 125-128 Apr. 1991

Avail: NTIS HC/MF A10

Collaborative studies in the general fields of gravity related physiology, of which microgravity research is becoming an essential part, are discussed. Studies include some of the following: tilt and volume regulation; the measurement of finger blood pressure by fingerpress on a K-135 parabolic flight; measurement of respiration, cardiovascular (particularly brain perfusion) and metabolic responses to microgravity under different levels of exercise; and the development of a mathematical model for the description of the cardiovascular responses to tilt maneuvers.

ESA

**N92-23073#** Institute for Perception RVO-TNO, Soesterberg (Netherlands).

**OTOLITH RESPONSES IN MAN DURING PARABOLIC FLIGHT**

J. T. MARCUS / In Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands

p 131-133 Apr. 1991  
 Avail: NTIS HC/MF A10

An experiment performed to investigate the influence of linear accelerations on the vestibular system, especially in the otoliths of six subjects is outlined. It is concluded that an otolith-ocular pathway modulates optokinetic eye movements in parabolic flight.  
 ESA

**N92-23139#** Civil Aeromedical Inst., Oklahoma City, OK.  
**RADIATION EXPOSURE OF AIR CARRIER CREWMEMBERS 2**  
**Final Report**

W. FRIEDBERG, L. SNYDER, D. N. FAULKNER, E. B. DARDEN, and K. OBRIEN Jan. 1992 21 p Prepared in cooperation with Oak Ridge Associated Universities, Inc., TN; and Univ. of Northern Arizona, Flagstaff Sponsored by FAA (PB92-140037; DOT/FAA-AM-92/2) Avail: NTIS HC/MF A03 CSCL 06P

The cosmic radiation environment at air carrier flight altitudes is described and estimates given of the amounts of galactic cosmic radiation received on a wide variety of routes to and from, and within the contiguous United States. Radiation exposure from radioactive air cargo is also considered. Methods are provided to assess health risks from exposure to galactic radiation. On the flights studied, the highest dose of galactic radiation received annually by a crewmember who worked as many as 1000 block hours a year would be less than half the annual limit recommended by the International Commission on Radiological Protection for a nonpregnant occupationally exposed adult. The radiation exposure for a pregnant crewmember who worked 70 block hours a month for five months would exceed the recommended 2-millisievert pregnancy limit on about one-third of the flights.  
 GRA

**N92-23424\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**SKELETAL RESPONSES TO SPACEFLIGHT**  
 EMILY MOREY-HOLTON and SARA B. ARNAUD Dec. 1991 35 p (NASA-TM-103890; A-91232; NAS 1.15:103890) Avail: NTIS HC/MF A03 CSCL 06P

The role of gravity in the determination of bone structure is elucidated by observations in adult humans and juvenile animals during spaceflight. The primary response of bone tissue to microgravity is at the interface of the mineral and matrix in the process of biomineralization. This response is manifested by demineralization or retarded growth in some regions of the skeleton and hypermineralization in others. The most pronounced effects are seen in the heelbone and skull, the most distally located bones relative to the heart. Ground based flight simulation models that focus on changes in bone structure at the molecular, organ, and whole body levels are described and compared to flight results. On Earth, the morphologic and compositional changes in the unloaded bones are very similar to changes during flight; however, the ground based changes appear to be more transient. In addition, a redistribution of bone mineral in gravity-dependent bones occurs both in space and during head down positioning on Earth. Longitudinal data provided considerable information on the influence of endocrine and muscular changes on bone structure after unloading.  
 Author

**N92-23603\*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**GENETIC AND MOLECULAR DOSIMETRY OF HZE RADIATION (7-IML-1)**

GREGORY A. NELSON /n NASA, Marshall Space Flight Center, First International Microgravity Laboratory Experiment Descriptions p 25-31 Feb. 1992  
 Avail: NTIS HC/MF A13 CSCL 06P

The objectives of the study are to determine the kinetics of production and to characterize the unique aspects of genetic and developmental lesion induced in animal cells by radiation present in the space environment. Special attention is given to heavy charged particles. The organism *Caenorhabditis elegans*, a simple

nematode, is used as a model system for a coordinated set of ground-based and flight experiments.  
 Author

**N92-23620\*#** Calgary Univ. (Alberta).  
**ENERGY EXPENDITURE IN SPACE FLIGHT (DOUBLY LABELLED WATER METHOD) (8-IML-1)**

HOWARD G. PARSONS /n NASA, Marshall Space Flight Center, First International Microgravity Laboratory Experiment Descriptions p 111-112 Feb. 1992  
 Avail: NTIS HC/MF A13 CSCL 06P

The objective of the Energy Expenditure in Space Flight (ESS) experiment is to demonstrate and evaluate the doubly labeled water method of measuring the energy expended by crew members during approximately 7 days in microgravity. The doubly labeled water technique determines carbon dioxide production which is then used to calculate energy expenditure. The method relies on the equilibrium between oxygen in respiratory carbon dioxide and oxygen in body water. Because of this equilibrium, the kinetic of water turnover and respiration are interdependent. Under normal conditions, man contains small but significant amounts of deuterium and oxygen 18. Deuterium is eliminated from the body as water while oxygen 18 is eliminated as water and carbon dioxide. The difference in the turnover rates in the two isotopes is proportional to the carbon dioxide production. Deliberately enriching the total body water with both of these isotopes allows the isotope turnovers to be accurately measured in urine, plasma, or saliva samples. The samples are taken to the laboratory for analysis using an ion-ratio spectrometer.  
 Author

**N92-23622\*#** British Columbia Univ., Vancouver. University Hospital/Shaghnessy Site.

**BACK PAIN IN ASTRONAUTS (8-IML-1)**

P. C. WING /n NASA, Marshall Space Flight Center, First International Microgravity Laboratory Experiment Descriptions p 117-119 Feb. 1992  
 Avail: NTIS HC/MF A13 CSCL 06P

As a preliminary study for the International Microgravity Laboratory (IML-1) experiment, a pain diagram was used to elicit information about the incidence and severity of back pain experienced by 20 payload specialists (PS) on 22 shuttle flights from 1983 to 1986. There were 18 responses from 17 PSs (one PS provided information about two missions). Thirteen PSs (72 percent) reported experiencing some degree of back pain, ranging from dull (can be ignored) to severe, making concentration difficult. For the majority, the pain was dull in nature, and did not interfere with work or concentration. For some, the pain abated after only a few minutes; for others, the pain persisted for the entire duration of the flight.  
 D.R.D.

**N92-23623\*#** Canadian Space Agency, Ottawa (Ontario).

**MEASUREMENT OF VENOUS COMPLIANCE (8-IML-1)**

R. B. THIRSK /n NASA, Marshall Space Flight Center, First International Microgravity Laboratory Experiment Descriptions p 121-122 Feb. 1992  
 Avail: NTIS HC/MF A13 CSCL 06P

The prime objective of this International Microgravity Laboratory (IML-1) investigation is to measure the bulk compliance (distensibility) of the veins in the lower leg before, during, and after spaceflight. It is of particular interest whether venous compliance over the range of both positive and negative transmural pressures (various states of venous distention and collapse) changes throughout the duration of spaceflight. Information concerning the occurrence and character of compliance changes could have implications for the design of improved antigravity suits and further the understanding of inflight and postflight venous hemodynamics.  
 Author

**N92-23624\*#** University of Western Ontario, London.

**POSITIONAL AND SPONTANEOUS NYSTAGMUS (8-IML-1)**

JOSEPH MCCLURE /n NASA, Marshall Space Flight Center, First International Microgravity Laboratory Experiment Descriptions p 123-124 Feb. 1992  
 Avail: NTIS HC/MF A13 CSCL 06P

Nystagmus is an involuntary oscillation of the eyes with a slow eye movement in one direction and a compensatory quick eye movement in the opposite direction to return the eyes to their original position. The slow phase of nystagmus is often generated by asymmetry in the peripheral vestibular system, and generally nystagmus in the horizontal direction dominates although vertical and rotary nystagmus can be seen in certain pathological situations. D.R.D.

**N92-23625\*#** McGill Univ., Montreal (Quebec).

**SPACE ADAPTATION SYNDROME EXPERIMENTS (8-IML-1)**

D. WATT /in NASA. Marshall Space Flight Center, First International Microgravity Laboratory Experiment Descriptions p 125-134 Feb. 1992

Avail: NTIS HC/MF A13 CSCL 06P

A set of seven experiments will study adaptation of the human nervous system to weightlessness. Particular emphasis will be placed on the vestibular and proprioceptive systems. The experiments are as follows: the sled/H-reflex; rotation/vestibulo-ocular reflex; the visual stimulator experiment; proprioception (relaxed) experiment; proprioception (active) experiment; proprioception (illusion) experiment; and tactile acuity. D.R.D.

**N92-23626\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

**MICROGRAVITY VESTIBULAR INVESTIGATIONS (10-IML-1)**

MILLARD F. RESCHKE /in NASA. Marshall Space Flight Center, First International Microgravity Laboratory Experiment Descriptions p 135-180 Feb. 1992

Avail: NTIS HC/MF A13 CSCL 06P

Our perception of how we are oriented in space is dependent on the interaction of virtually every sensory system. For example, to move about in our environment we integrate inputs in our brain from visual, haptic (kinesthetic, proprioceptive, and cutaneous), auditory systems, and labyrinths. In addition to this multimodal system for orientation, our expectations about the direction and speed of our chosen movement are also important. Changes in our environment and the way we interact with the new stimuli will result in a different interpretation by the nervous system of the incoming sensory information. We will adapt to the change in appropriate ways. Because our orientation system is adaptable and complex, it is often difficult to trace a response or change in behavior to any one source of information in this synergistic orientation system. However, with a carefully designed investigation, it is possible to measure signals at the appropriate level of response (both electrophysiological and perceptual) and determine the effect that stimulus rearrangement has on our sense of orientation. The environment of orbital flight represents the stimulus arrangement that is our immediate concern. The Microgravity Vestibular Investigations (MVI) represent a group of experiments designed to investigate the effects of orbital flight and a return to Earth on our orientation system. Author

**N92-24033#** Columbia Univ., New York, NY.

**LOW DOSE NEUTRON LATE EFFECTS: CATARACTOGENESIS**

B. V. WORGUL Dec. 1991 6 p

(Contract DE-FG02-90ER-61009)

(DE92-005539; DOE/ER-61009/2) Avail: NTIS HC/MF A02

The work is formulated to resolve the uncertainty regarding the relative biological effectiveness (RBE) of low dose neutron radiation. The study exploits the fact that cataractogenesis is sensitive to the inverse dose-rate effect as has been observed with heavy ions and was an endpoint considered in the follow-up of the A-bomb survivors. The neutron radiations were initiated at the Radiological Research Accelerator Facility (RARAF) of the Nevis Laboratory of Columbia University. Four week old (plus or minus 1 day) rats were divided into eight dose groups each receiving single or fractionated total doses of 0.2, 1.0, 5.0 and 25.0 cGy of monoenergetic 435 KeV neutrons. Special restraining jigs insured that the eye, at the midpoint of the lens, received the appropriate energy and dose with a relative error of plus or minus 5 percent. The fractionation regimen consisted of four exposures, each

administered at three hour (plus minus) intervals. The neutron irradiated groups are being compared to rats irradiated with 250 kVp x-rays in doses ranging from 0.5 to 7 Gy. The animals are being examined on a biweekly basis utilizing conventional slit-lamp biomicroscopy and the Scheimpflug Slit Lamp Imaging System (Zeiss). The follow-ups, entering their second year, will continue throughout the life-span of the animals. This is essential inasmuch as given the extremely low doses which are being utilized, clinically detectable opacities were not anticipated until a significant fraction of the life span has lapsed. Current data support this contention. At this juncture, cataracts in the irradiated groups are beginning to exceed control levels. DOE

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Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

**A92-32951**

**NIGHT VISION GOGGLE TRAINING IN THE UNITED STATES COAST GUARD**

STEPHEN M. HICKOK (USCG, Aviation Training Center, Mobile, AL) Aeromedical & Training Digest, vol. 6, April 1992.

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A review is presented of the Night Vision Lab training program conducted by the USCG consisting of: an eye lane for goggle adjustments and light intensity demonstrations, and a night vision goggle terrain board for simulating a series of scenarios over water, off-shore, and land. Training scenarios are structured to demonstrate visibility factors that pilots should consider when planning missions. Relative motion and loss of color distinction is demonstrated, duplicating a typical situation where there are multiple search aircraft sharing the same airspace. Attention is given to ANVIS, the Aviator's Night Vision Imaging System goggles worn by all aircrew. R.E.P.

**A92-33803\*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**OUTCOMES OF CREW RESOURCE MANAGEMENT TRAINING**

ROBERT L. HELMREICH and JOHN A. WILHELM (Texas, University, Austin) International Journal of Aviation Psychology (ISSN 1050-8414), vol. 1, no. 4, 1991, p. 287-300. refs (Contract NCC2-286)

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Participants' self-reports and measures of attitudes regarding flightdeck management indicate that crew resource management training is favorably received and causes highly significant, positive changes in attitudes regarding crew coordination and personal capabilities. However, a subset of participants reacted negatively to the training and showed boomerangs (negative change) in attitudes. Explorations into the causes of this effect pinpoint personality factors and group dynamics as critical determinants of reactions to training and of the magnitude and direction of attitude changes. Implications of these findings for organizations desiring to enhance crew effectiveness are discussed, and areas of needed additional research are described. Author

**A92-33804**

**THE IMPACT OF PERSONALITY AND TASK CHARACTERISTICS ON STRESS AND STRAIN DURING HELICOPTER FLIGHT**

CLAUDIA HARSS, MICHAEL KASTNER, and LILLY BEERMAN (Muenchen, Universitaet der Bundeswehr, Munich, Federal Republic of Germany) International Journal of Aviation Psychology (ISSN 1050-8414), vol. 1, no. 4, 1991, p. 301-318. refs

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Over a three year period a longitudinal research project was conducted on the stress and strain of helicopter pilots engaged in

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low-altitude night flight using night vision goggles. In this theoretical model, stress and strain in flight result from concrete actions by specific pilots in specific objectively definable situations. As examples for concrete interactions between situational variables and personality, the observed stress of helicopter crews, which relies on the personality characteristics of riskiness and test anxiety (worry cognitions), and situation-characteristic difficulty are presented. R.E.P.

**A92-33805**

### THE DEVELOPMENT AND EVALUATION OF FLIGHT INSTRUCTORS - A DESCRIPTIVE SURVEY

IRENE HENLEY (Newcastle, University, Australia) International Journal of Aviation Psychology (ISSN 1050-8414), vol. 1, no. 4, 1991, p. 319-333. refs

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Results from a survey of flight instructors and flight training standards inspectors in Canada show that flight instructor training is still heavily influenced by traditional methods of instruction, such as rote learning and the mimicking of another instructor's speech pattern. Both inspectors and flight instructors stated that training should provide competency in teaching techniques and a more complete knowledge of evaluation and learning theories. Senior instructors who teach the flight instructor course are urged to receive additional training before they are authorized to instruct others how to teach as the quality of flight training rests with them. R.E.P.

**A92-33806**

### SIMULATOR QUALIFICATION - JUST AS PHONY AS IT CAN BE

STANLEY N. ROSCOE (ILLIANA Aviation Sciences, Ltd., Arcata, CA and Las Cruces, NM) International Journal of Aviation Psychology (ISSN 1050-8414), vol. 1, no. 4, 1991, p. 335-339. refs

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The qualification of airplane simulators for pilot training is based on the assumption that transfer of such training is directly related to the similarity of the device to an actual airplane. The consequence of this widely held position has been the specification of training device requirements solely on the basis of engineering criteria. However, the proper criterion is the flight hours saved in airborne training for each incremental investment in ground training. Furthermore, research has shown that innovations in training strategies, in some cases involving intentional departures from reality, can have stronger effects than high simulator fidelity on the resulting quality of pilot performance. Ideally, each aspect of the training curriculum could be taught to some criterion performance level on the ground. Competence in each block of training would be demonstrated after a brief transition in the airplane. Certification for each license and rating would be based on demonstrated competence, thereby making possible large reductions in the minimum required flying hours. Credit for-ground based training would no longer be a formal issue. Author

**A92-33901** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

### TRANSFER OF CONTRAST SENSITIVITY IN LINEAR VISUAL NETWORKS

ANDREW B. WATSON (NASA, Ames Research Center, Moffett Field, CA) Visual Neuroscience (ISSN 0952-5238), vol. 8, 1992, p. 65-76. refs

(Contract RTOP 506-47-11)

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Contrast sensitivity is a useful measure of the ability of an observer to distinguish contrast signals from noise. Although usually applied to human observers, contrast sensitivity can also be defined operationally for individual visual neurons. In a model linear neuron consisting of a filter and noise source, this operational measure is a function of filter gain, noise power spectrum, signal duration, and a performance criterion. This definition allows one to relate the sensitivities of linear neurons at different levels in the visual pathway. Mathematical formulas describing these relationships are

derived, and the general model is applied to the specific problem of relating the sensitivities of parvocellular LGN neurons and cortical simple cells in the primate. Author

**A92-33902\*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

### STRUCTURE AND STRATEGY IN ENCODING SIMPLIFIED GRAPHS

DIANE J. SCHIANO (NASA, Ames Research Center, Moffett Field, CA) and BARBARA TVERSKY (Stanford University, CA) Memory and Cognition (ISSN 0090-502X), vol. 20, 1992, p. 12-20. refs

(Contract AF-AFOSR-89-0076)

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Tversky and Schiano (1989) found a systematic bias toward the 45-deg line in memory for the slopes of identical lines when embedded in graphs, but not in maps, suggesting the use of a cognitive reference frame specifically for encoding meaningful graphs. The present experiments explore this issue further using the linear configurations alone as stimuli. Experiments 1 and 2 demonstrate that perception and immediate memory for the slope of a test line within orthogonal 'axes' are predictable from purely structural considerations. In Experiments 3 and 4, subjects were instructed to use a diagonal-reference strategy in viewing the stimuli, which were described as 'graphs' only in Experiment 3. Results for both studies showed the diagonal bias previously found only for graphs. This pattern provides converging evidence for the diagonal as a cognitive reference frame in encoding linear graphs, and demonstrates that even in highly simplified displays, strategic factors can produce encoding biases not predictable solely from stimulus structure alone. Author

**A92-33915\*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

### PERCEPTS OF RIGID MOTION WITHIN AND ACROSS APERTURES

MAGGIE SHIFFRAR (Stanford University, CA) and M. PAVEL (New York University, NY) Journal of Experimental Psychology: Human Perception and Performance (ISSN 0096-1523), vol. 17, no. 3, 1991, p. 749-761. refs

(Contract AF-AFOSR-84-0308; NCC2-269)

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Humans consistently err in their percepts of rotational motion viewed through an aperture. Such errors provide insight into the constraints observers use to interpret retinal images. In the first of two experiments, Ss consistently perceived the fixed center of rotation for an unmarked line viewed through an aperture as located on the line, regardless of its actual location. Accuracy greatly improved with visible line endings. This finding was extended to explain why a square appears nonrigid when it rotates behind a partial occluder. This illusion may result from observers misperceiving the center of rotation of the unmarked square sides. In this situation, Ss seemed unable to apply an object rigidity constraint across apertures. These findings support a conceptualization of the visual system in which consistent local information must be clearly present before prior knowledge can be used to interpret retinal stimulation. Author

**N92-22331\*#** Aerospace Medical Research Labs., Wright-Patterson AFB, OH. Optical Systems Branch.

### EFFECT OF MICROGRAVITY ON SEVERAL VISUAL FUNCTIONS DURING STS SHUTTLE MISSIONS

MELVIN R. ONEAL, H. LEE TASK, and LOUIS V. GENCO /n NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 468-475 Feb. 1992 Previously announced in IAA as A91-14170

Avail: NTIS HC/MF A17 CSDL 051

Changes in the acuity of astronaut vision during flight are discussed. Parameters such as critical flicker vision, stereopsis to 10 seconds of arc, visual acuity in small steps to 20/7.7, cyclophoria, lateral and vertical phoria and retinal rivalry were tested using a visual function tester. Twenty-three Space Transportation System (STS) astronauts participated in the experiments. Their



vision was assessed twice before launch and after landing, and three to four times while on-orbit and landing. No significant differences during space flight were observed for any of the visual parameters tested. In some cases, slight changes in acuity and stereopsis were observed with a subsequent return to normal vision after flight.

Author

**N92-22334\*#** Aerospace Medical Research Labs., Wright-Patterson AFB, OH.

**THE EFFECTS OF MULTIPLE AEROSPACE ENVIRONMENTAL STRESSORS ON HUMAN PERFORMANCE**

S. E. POPPER, D. W. REPPERGER, K. MCCLOSKEY, and L. D. TRIPP (Systems Research Labs., Inc., Dayton, OH.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 487-495 Feb. 1992

Avail: NTIS HC/MF A17 CSCL 05I

An extended Fitt's law paradigm reaction time (RT) task was used to evaluate the effects of acceleration on human performance in the Dynamic Environment Simulator (DES) at Armstrong Laboratory, Wright-Patterson AFB, Ohio. This effort was combined with an evaluation of the standard CSU-13 P anti-gravity suit versus three configurations of a 'retrograde inflation anti-G suit'. Results indicated that RT and error rates increased 17 percent and 14 percent respectively from baseline to the end of the simulated aerial combat maneuver and that the most common error was pressing too few buttons.

Author

**N92-22335\*#** Aerospace Medical Research Labs., Brooks AFB, TX. Sustained Operations Branch.

**MICROGRAVITY EFFECTS ON STANDARDIZED COGNITIVE PERFORMANCE MEASURES**

SAMUEL G. SCHIFLETT *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 496-505 Feb. 1992

Avail: NTIS HC/MF A17 CSCL 05I

The purpose of this experiment, selected to fly on the International Microgravity Laboratory (IML-2) Spacelab mission, is to determine the effects of microgravity upon the cognitive skills which are critical to successful performance of many tasks on board the Space Shuttle. Six tests from the Unified Tri-service Cognitive Performance Assessment Battery (UTC-PAB) will be administered to the Mission Specialists to fulfill the goals of this experiment. These tests are based upon current theoretical models of human performance and the hypothesized effects of microgravity. The principle objective is the identification of the effects of microgravity upon specific information processing skills affecting performance from those of fatigue and shifts in work/rest cycles. Multiple measures of both short and long term fatigue will be obtained and used as a major independent variable for the analysis of these performance data. Scientific supporting studies will determine optimum practice and performance testing schedules for the astronauts. The same tests will be used post-flight to collect data on the recovery of any cognitive performance impairment compared with pre-flight, baseline levels.

Author

**N92-22341\*#** Aerospace Medical Research Labs., Wright-Patterson AFB, OH.

**SITUATION AWARENESS IN COMMAND AND CONTROL SETTINGS Abstract Only**

ROBERT W. PATTERSON *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 544 Feb. 1992

Avail: NTIS HC/MF A17 CSCL 05I

Many military and civilian operational settings are described as command and control (C2) environments characterized by high information load, extensive team coordination, and communication demands. To address these problems, designers have turned to the application of automation and decision aids. Currently, there are few techniques for assessing the performance of C2 operators with which to guide applications. A need exists for constructs on which to evaluate C2 systems. One possible concept for addressing these issues is that of Situation Awareness (SA). The SA concept

and methodologies have developed largely around the cockpit environment. The extension is discussed of the SA concept to a team context related to C2 environments. Then the implications of such an approach for developing a methodology to empirically measure team SA in a C2 environment which should allow for the assessment of SA of both individual operators and overall SA of operational teams. The discussion also focuses on how a knowledge of SA may impact the design and development of systems which optimize rather than maximize information access and processing and, subsequently, improve C2 decision making.

Author

**N92-22342\*#** Aerospace Medical Research Labs., Wright-Patterson AFB, OH.

**EVALUATING HUMAN PERFORMANCE MODELING FOR SYSTEM ASSESSMENT: PROMISE AND PROBLEMS**

ROBERT W. PATTERSON and MICHAEL J. YOUNG *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 545 Feb. 1992

Avail: NTIS HC/MF A17 CSCL 05I

The development and evaluation of computational human performance models is examined. An intention is to develop models which can be used to interact with system prototypes and simulations to perform system assessment. Currently LR is working on a set of models emulating cognitive, psychomotor, auditory, and visual activity for multiple operator positions of a command and control simulation system. These models, developed in conjunction with BBN Systems and Technologies, function within the simulation environment and allow for both unmanned system assessment and manned (human-in-loop) assessment of system interface and team interactions. These are relatively generic models with built-in flexibility which allows modification of some model parameters. These models have great potential for improving the efficiency and effectiveness of system design, test, and evaluation. However, the extent of the practical utility of these models is unclear. Initial verification efforts comparing model performance within the simulation to actual human operators on a similar, independent simulation have been performed and current efforts are directed at comparing human and model performance within the same simulation environment.

Author

**N92-22347\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**ANGULAR RELATION OF AXES IN PERCEPTUAL SPACE**

URS BUCHER *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 575-581 Feb. 1992 Prepared in cooperation with Zurich Univ. (Switzerland)

Avail: NTIS HC/MF A17 CSCL 05I

The geometry of perceptual space needs to be known to model spatial orientation constancy or to create virtual environments. To examine one main aspect of this geometry, the angular relation between the three spatial axes was measured. Experiments were performed consisting of a perceptual task in which subjects were asked to set independently their apparent vertical and horizontal plane. The visual background provided no other stimuli to serve as optical direction cues. The task was performed in a number of different body tilt positions with pitches and rolls varied in steps of 30 degs. The results clearly show the distortion of orthogonality of the perceptual space for nonupright body positions. Large interindividual differences were found. Deviations from orthogonality up to 25 deg were detected in the pitch as well as in the roll direction. Implications of this nonorthogonality on further studies of spatial perception and on the construction of virtual environments for human interaction is also discussed.

Author

**N92-22349\*#** Krug Life Sciences, Inc., San Antonio, TX.

**TRACKING PERFORMANCE WITH TWO BREATHING OXYGEN CONCENTRATIONS AFTER HIGH ALTITUDE RAPID DECOMPRESSION**

THOMAS E. NESTHUS, SAMUEL G. SCHIFLETT, and CAROLYN J. OAKLEY (Aerospace Medical Research Labs., Brooks AFB,

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TX.) /n NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 590-594 Feb. 1992  
Avail: NTIS HC/MF A17 CSCL 051

Current military aircraft Liquid Oxygen (LOX) systems supply 99.5 pct. gaseous Aviator's Breathing Oxygen (ABO) to aircrew. Newer Molecular Sieve Oxygen Generation Systems (MSOGS) supply breathing gas concentration of 93 to 95 pct. O<sub>2</sub>. The margin is compared of hypoxia protection afforded by ABO and MSOGS breathing gas after a 5 psi differential rapid decompression (RD) in a hypobaric research chamber. The barometric pressures equivalent to the altitudes of 46000, 52000, 56000, and 60000 ft were achieved from respective base altitudes in 1 to 1.5 s decompressions. During each exposure, subjects remained at the simulated peak altitude breathing either 100 or 94 pct. O<sub>2</sub> with positive pressure for 60 s, followed by a rapid descent to 40000 ft. Subjects used the Tactical Life Support System (TLSS) for high altitude protection. Subcritical tracking task performance on the Performance Evaluation Device (PED) provided psychomotor test measures. Overall tracking task performance results showed no differences between the MSOGS breathing O<sub>2</sub> concentration of 94 pct. and ABO. Significance RMS error differences were found between the ground level and base altitude trials compared to peak altitude trials. The high positive breathing pressures occurring at the peak altitudes explained the differences. Author

**N92-22466\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

### EXTENDED ATTENTION SPAN TRAINING SYSTEM

ALAN T. POPE and EDWARD H. BOGART (Lockheed Engineering and Sciences Co., Hampton, VA.) /n NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 p 368-374 Dec. 1991  
Avail: NTIS HC/MF A23 CSCL 051

Attention Deficit Disorder (ADD) is a behavioral disorder characterized by the inability to sustain attention long enough to perform activities such as schoolwork or organized play. Treatments for this disorder include medication and brainwave biofeedback training. Brainwave biofeedback training systems feed back information to the trainee showing him how well he is producing the brainwave pattern that indicates attention. The Extended Attention Span Training (EAST) system takes the concept a step further by making a video game more difficult as the player's brainwaves indicate that attention is waning. The trainee can succeed at the game only by maintaining an adequate level of attention. The EAST system is a modification of a biocybernetic system that is currently being used to assess the extent to which automated flight management systems maintain pilot engagement. This biocybernetic system is a product of a program aimed at developing methods to evaluate automated flight deck designs for compatibility with human capabilities. The EAST technology can make a contribution in the fields of medical neuropsychology and neurology, where the emphasis is on cautious, conservative treatment of youngsters with attention disorders. Author

**N92-22670#** Helsinki Univ. of Technology, Espoo (Finland). Lab. of Industrial Psychology.

### MENTAL WORKLOAD: RESEARCH ON COMPUTER-AIDED DESIGN WORK AND ON THE IMPLEMENTATION OF OFFICE AUTOMATION Ph.D. Thesis

EILA JAERVENPAEAE 1991 294 p Sponsored by Academy of Finland; Aaltonen Foundation; and Anna S. Elonen Foundation (REPT-130/1991/TPS; ISBN-951-22-0572-6; ISSN-0784-3623; PB92-127372; ETN-92-91174) Avail: NTIS HC/MF A13

A study to test and develop research methods on mental workload and to study mental workload in jobs which involve the use of information technology, with focus on short term mental strain, is presented. Theoretical and research approaches and previous finding are considered. Mental workload among CAD (Computer Aided Design) designers was studied by means of a cross sectional design. The effects of the implementation of office automation on mental workload among distinct court personnel are studied longitudinally. In rather low demanding work, job

demands were positively connected with positive short term mental strain. When job demands were in the intermediate level autonomy also became important with regard to positive short term mental strain. In highly demanding jobs, feedback from the job itself became an important job characteristic that was partly independent of job demands in affecting positive short term mental strain in all jobs studied. However, feedback from other people seemed to be slightly more important in less demanding jobs. ESA

**N92-23628\*#** Massachusetts Inst. of Tech., Cambridge.

### MENTAL WORKLOAD AND PERFORMANCE EXPERIMENT (15-IML-1)

HAROLD L. ALEXANDER /n NASA. Marshall Space Flight Center, First International Microgravity Laboratory Experiment Descriptions p 183-187 Feb. 1992

Avail: NTIS HC/MF A13 CSCL 051

Whether on Earth or in space, people tend to work more productively in settings designed for efficiency and comfort. Because comfortable and stress-free working environments enhance performance and contribute to congenial relationships among co-workers, the living and working arrangements for spacecraft to be used for missions lasting months or years assume particular importance. The Mental Workload and Performance Experiment (MWPE), in part, examines the appropriate design of workstations for performance of various tasks in microgravity, by providing a variable-configuration workstation that may be adjusted by the astronauts. Author

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### MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

**A92-32976**

### ANNUAL SAFE SYMPOSIUM, 28TH, SAN ANTONIO, TX, DEC. 11-13, 1990, PROCEEDINGS

Newhall, CA, SAFE Association, 1991, 243 p. For individual items see A92-32977 to A92-32999.  
Copyright

The present conference on life support and survival technology encompasses testing and training methodologies for spatial disorientation, advances in restraint and escape technology, hardware for safety and survival applications, active noise reduction, life-support systems, and the modeling of contaminant behavior. Specific issues addressed include a noninvasive blood-pressure measurement technique, helmets for tactical aircrews and the Cobra helicopter, a cats-eyes emergency detachment system, the use of composite materials for test manikins, inertia reels for aircrew restraint systems, the physiological response to pressure breathing, and the use of laser-initiated ordnance on a manned-rated vehicle. Also addressed are spatial disorientation training, a centrifuge for tactical aircrew training, the output testing of small-arms primers, cartridge-output testing, a laser-initiated transfer energy subsystem, a breathing regulator/anti-G valve, and the developmental status of aviation life-support and rescue equipment. C.C.S.

**A92-32977**

### DEVELOPMENT OF THE HGU-67/P HELMET FOR THE AH-1W (COBRA) HELICOPTER

CHRISTINA A. HORVAT and GREGORY K. REH (U.S. Navy, Naval Air Development Center, Warminster, PA) IN: Annual SAFE Symposium, 28th, San Antonio, TX, Dec. 11-13, 1990, Proceedings. Newhall, CA, SAFE Association, 1991, p. 1-6. refs  
Copyright

The requirements and design of an advanced helicopter helmet are described with particular attention given to the helmet features which directly enhance crew operational efficiency. The present



HGU-67/P is designed to eliminate the poor center of gravity, low helmet retention, and excessive weight of previous designs and enhance integration with the helmet-sight system. The present design incorporates a custom-fit liner and a low-profile shell, and stability and retention are enhanced with an integrated chin/nape strap. Impact and sound attenuation are improved with the introduction of tapered crushable earcups, and the mount is compatible with the Cobra helicopter subsystems. Testing of the present version in the laboratory and in helicopter missions is mentioned, and the novel helmet design is concluded to provide the required protection for mission/threat scenarios. C.C.S.

**A92-32978**  
**U.S. NAVY/MARINE CORPS REPLACEMENT HELMET FOR TACTICAL AIRCREW**

DANIEL J. SCHMIDT (U.S. Navy, Naval Air Development Center, Warminster, PA) IN: Annual SAFE Symposium, 28th, San Antonio, TX, Dec. 11-13, 1990, Proceedings. Newhall, CA, SAFE Association, 1991, p. 22-25. Copyright

The development and testing of components for a final helmet design are discussed with attention given to performance comparisons and the final design. Descriptions are given of the Night Attack helmet, the Tacair Helmet Replacement, and helmet component such as the chin/nape strap and the thermoplastic liner. The final configuration of the U.S. Navy/Marine Corps replacement helmet for tactical crews is made up of components that are ready for production. The shell is based on a nylon/graphite composite with a press-fit leather edgeroll to eliminate the holes required for a sew-in. A preformed thermoplastic liner and a modified visor complement the shell, and the final configuration is illustrated. The Z component of the helmet's center of gravity is improved by 8 mm, the weight is reduced by up to 282 grams, and the field of view is enhanced by reducing the shell area near the eyes of the crewmember. C.C.S.

**A92-32981**  
**DEVELOPMENT OF A CATS-EYES EMERGENCY DETACHMENT SYSTEM**

GREGORY K. REH, DANIEL J. SCHMIDT (U.S. Navy, Naval Air Development Center, Warminster, PA), and RICKY L. GRETH (Logistics Management Engineering, Inc., Warminster, PA) IN: Annual SAFE Symposium, 28th, San Antonio, TX, Dec. 11-13, 1990, Proceedings. Newhall, CA, SAFE Association, 1991, p. 59-64. refs Copyright

Aircrewmembers flying ejection-seat aircraft with Night Vision Goggle Sensors (NVGS) are subjected to a high risk of serious injury during ejection due to the additional torque on the neck produced by the offset center-of-gravity (CG) and acceleration forces during an ejection. The Naval Air Development Center is developing a system that will release the NVGS from the helmet upon initiation of the ejection sequence. The NVGS are released from the helmet before injurious loads and accelerations are imparted to the upper thoracic and cervical spine. The Cats-Eyes Emergency Detachment System (CEEDS) is intended to be a secondary mode of releasing the NVGS. The primary mode will remain manual release.

Author

**A92-32985**  
**PHYSIOLOGICAL RESPONSE TO PRESSURE BREATHING WITH A CAPSTAN COUNTER PRESSURE VEST**

H. J. XIAO and D. Y. HE (Air Force PR China, Institute of Aviation Medicine, Beijing, People's Republic of China) IN: Annual SAFE Symposium, 28th, San Antonio, TX, Dec. 11-13, 1990, Proceedings. Newhall, CA, SAFE Association, 1991, p. 115-117. refs Copyright

Physiological tolerance to positive pressure breathing (PPB) is investigated experimentally in subjects using capstan pressure vests at pressures of 6.37-8.33 KPa and altitudes of 15-16.5 km. A pronounced decrease in stroke volume is noted, but the PPB in the test range does not markedly affect breathing when the counterpressure vest is employed. The capstan pressure vest can

be utilized for short periods of protection instead of the capstan pressure body garment at altitudes of up to 16.5 km. The vest is a more comfortable and efficient alternative to the cumbersome body garment for these applications. C.C.S.

**A92-32995**  
**BREATHING REGULATOR/ANTI-G (BRAG) VALVE - A SYSTEMS APPROACH TO AIRCRAFT LIFE SUPPORT EQUIPMENT**

MICHAEL T. JACKSON and MICHAEL F. RATAJCZAK (Carleton Technologies, Inc., Orchard Park, NY) IN: Annual SAFE Symposium, 28th, San Antonio, TX, Dec. 11-13, 1990, Proceedings. Newhall, CA, SAFE Association, 1991, p. 176-180. Research supported by Boeing Advanced Systems Co. refs Copyright

The development and testing of a breathing regulator/anti-G (BRAG) valve are described emphasizing the systems approach to altitude/acceleration protection. The BRAG valve integrates a mechanical breathing regulator with an electronic anti-G valve in a vest configuration which can be used with or without positive-pressure breathing ensembles. Bench testing and centrifuge and hypobaric chamber tests are described, and the results are compared with BRAG valve specifications. The BRAG equipment is found to operate near or at specification levels for breathing resistance, dilution performance, and breathing pressures in the 'vest' and 'vest off' modes. The BRAG valve can contribute to the reduction of pilot fatigue by minimizing required breathing effort and by affording acceleration protection. Further testing is required to assess the use of the BRAG valve with existing aircrew equipment. C.C.S.

**A92-32996**  
**MODELING OF CONTAMINANT BEHAVIOR IN OBOGS**

GLENN MUNKVOLD, KENNETH TEAGUE, THOMAS F. EDGAR, and JOSEPH J. BEAMAN (Texas, University, Austin) IN: Annual SAFE Symposium, 28th, San Antonio, TX, Dec. 11-13, 1990, Proceedings. Newhall, CA, SAFE Association, 1991, p. 181-186. refs Copyright

Analytical modeling and experimental verification of the dynamic response of on-board oxygen-generation systems (OBOGSs) to feed-air composition are conducted to evaluate the effects of using outside air. Attention is given to predicting the dynamic response of an OBOGS system to the pressure, temperature, and composition of the feed air. The model assumes an isothermal system, constant properties, and either ideal absorbed-solution theory or uncoupled isotherms for describing the adsorbed phase equilibrium. Four different two-bed pressure-swing adsorption (PSA) units are used in more than 100 experiments to validate the physical model, and cycle time is found to maximize product oxygen while conserving feed. The model is shown to predict the product oxygen concentrations well for the PSA data, and Freon-12 is found to be concentrated in the product stream of dual-bed PSA air-separation units on pelletized zeolite 5A. The results are considered to be general for any contaminant with a low mass-transfer coefficient and a low Henry's Law coefficient.

C.C.S.

**A92-32997**  
**DYNAMIC TESTING AND ENHANCEMENT OF AN ANATOMICALLY REPRESENTATIVE PELVIS AND INTEGRATED ELECTRONICS SUBSYSTEM**

PAUL H. FRISCH, WILLIAM BOULAY (Applied Physics, Inc., Nanuet, NY), JOHN QUARTUCCIO, and TERRY JAGOE (U.S. Navy, Naval Air Development Center, Warminster, PA) IN: Annual SAFE Symposium, 28th, San Antonio, TX, Dec. 11-13, 1990, Proceedings. Newhall, CA, SAFE Association, 1991, p. 187-191. refs Copyright

The requirements are outlined for an anatomically representative pelvis for studying biodynamic responses to aerospace seating and restraint systems with integrated electronics. Advanced manikin forms for studying these responses need to provide biofidelity

and instrument support to permit comparisons with known responses. The proposed manikin (BFM2) uses the sensor configuration and operational characteristics of previous manikin/electronics systems, and the pelvic design is based on that of Frisch and Ayoub (1990). The system was tested on a horizontal accelerator at variable G levels up to 48 G to test the pelvis, integrated electronics, and cable harness. The pelvis demonstrates structural integrity in all of the tests, and the analog subsystem operates effectively at all acceleration profiles. A version of the present pelvis is described and illustrated to show its capacity for anatomical modifications and experimental uses. C.C.S.

**A92-33192\*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

## NEURAL JOINT CONTROL FOR SPACE SHUTTLE REMOTE MANIPULATOR SYSTEM

MARK A. ATKINS, CHADWICK J. COX, MICHAEL D. LOTHERS, ROBERT M. PAP (Accurate Automation Corp., Chattanooga, TN), and CHARLES R. THOMAS (Accurate Automation Corp., Chattanooga, TN; Covenant College, Lookout Mountain, GA) AIAA, Aerospace Design Conference, Irvine, CA, Feb. 3-6, 1992. 11 p. refs

(Contract NAS8-38967; N00014-91-C-0268; NSF ECS-89-12896) (AIAA PAPER 92-1000) Copyright

Neural networks are being used to control a robot arm in a telerobotic operation. The concept uses neural networks for both joint and inverse kinematics in a robotic control application. An upper level neural network is trained to learn inverse kinematic mappings. The output, a trajectory, is then fed to the Decentralized Adaptive Joint Controllers. This neural network implementation has shown that the controlled arm recovers from unexpected payload changes while following the reference trajectory. The neural network-based decentralized joint controller is faster, more robust and efficient than conventional approaches. Implementations of this architecture are discussed that would relax assumptions about dynamics, obstacles, and heavy loads. This system is being developed to use with the Space Shuttle Remote Manipulator System. Author

**A92-33200#**

## FLIGHT TELEROBOTIC SERVICER (FTS) MANIPULATOR ACTUATORS - DESIGN OVERVIEW

STEFAN B. DELIN (Schaeffer Magnetics, Inc., Chatsworth, CA) AIAA, Aerospace Design Conference, Irvine, CA, Feb. 3-6, 1992. 9 p. refs

(AIAA PAPER 92-1014) Copyright

Development and acceptance tests of the Flight Telerobotic Servicer manipulator actuators have been completed. The actuators are based on a proven design concept of closely integrating the efficiency of a brushless dc motor with the simplicity of a harmonic drive speed reducer. The resulting actuator is very compact, with extremely stiff construction and excellent servo characteristics. The three phase brushless dc motors are redundant and commutated via Hall effect sensors. Each actuator further integrates a failsafe electromagnetic brake to maintain position in unpowered condition, a high resolution 23-bit inductive sensor and a linear torque sensor. A specially developed flex cable assembly with more than 500 lines is internally routed and allows low drag joint rotation. The actuators are very appropriate for advanced applications in systems utilizing artificial intelligence and represent a notable forward step in robotics technology. Author

**A92-33201\*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

## DESIGNING MINIMAL SPACE TELEROBOTICS SYSTEMS FOR MAXIMUM PERFORMANCE

PAUL G. BACKES, MARK K. LONG, and ROBERT D. STEELE (JPL, Pasadena, CA) AIAA, Aerospace Design Conference, Irvine, CA, Feb. 3-6, 1992. 9 p. refs

(AIAA PAPER 92-1015) Copyright

The design of the remote site of a local-remote telerobot control system is described which addresses the constraints of limited computational power available at the remote site control system

while providing a large range of control capabilities. The Modular Telerobot Task Execution System (MOTES) provides supervised autonomous control, shared control and teleoperation for a redundant manipulator. The system is capable of nominal task execution as well as monitoring and reflex motion. The MOTES system is minimized while providing a large capability by limiting its functionality to only that which is necessary at the remote site and by utilizing a unified multi-sensor based impedance control scheme. A command interpreter similar to one used on robotic spacecraft is used to interpret commands received from the local site. The system is written in Ada and runs in a VME environment on 68020 processors and initially controls a Robotics Research K1207 7 degree of freedom manipulator. Author

**A92-33202\*#** National Aeronautics and Space Administration, Washington, DC.

## DESIGN EVOLUTION OF A TELEROBOTIC SERVICER THROUGH NEUTRAL BUOYANCY SIMULATION

DAVID L. AKIN, RUSSELL D. HOWARD, JENNIFER A. SMITH, and JOSEPH GRAVES (Maryland, University, College Park) AIAA, Aerospace Design Conference, Irvine, CA, Feb. 3-6, 1992. 8 p.

(Contract NAGW-2245)

(AIAA PAPER 92-1016) Copyright

This paper briefly recounts the history of telerobotic vehicles in the Space Systems Laboratory. Based on this overview, the design of two vehicles are examined in depth, and directly compared. The Beam Assembly Teleoperator was the first true telerobot designed by the Space Systems Laboratory, and has been used extensively for six years. Ranger is the newest telerobot of the SSL, and is currently under development for operational testing in the summer of 1992. The primary focus of this paper is to compare and contrast the design details of these two telerobots, and to examine in some detail the evolution of design knowledge on some telerobots gained over the years of neutral buoyancy testing in the SSL. Author

**A92-33226#**

## CREW CENTERED COCKPIT DESIGN METHODOLOGY

MICHAEL N. STOLLINGS and JOHN R. AMELL (Boeing Military Airplanes, Seattle, WA) AIAA, Aerospace Design Conference, Irvine, CA, Feb. 3-6, 1992. 7 p. refs

(AIAA PAPER 92-1046) Copyright

The overwhelming flow of technology into the cockpit has created changes in the traditional approaches to the evaluation of pilot workload and mission effectiveness. Cockpit design processes must take into account the impact of advanced technologies early in the design process to not only reduce design risk but ensure improved mission effectiveness and pilot performance. This paper describes an interactive, computer-based cockpit design process developed as part of the Cockpit Automation Technology (CAT) Program sponsored by the Armstrong Laboratory, Human Engineering Division. The goal of this process is to not only improve the efficiency of cockpit design activities but to greatly improve overall design confidence. The described process provides a systematic method for cockpit design directed at improving the development, documentation application, and validation of how a cockpit should be designed, and how computer-aiding can enhance analysis and design activities. Author

**A92-33227#**

## TACTICAL AIRCRAFT COCKPIT STUDIES - THE IMPACT OF ADVANCED TECHNOLOGIES ON THE PILOT VEHICLE INTERFACE

GREGORY J. BARBATO (USAF, Wright Laboratory, Wright-Patterson AFB, OH) AIAA, Aerospace Design Conference, Irvine, CA, Feb. 3-6, 1992. 7 p. refs

(AIAA PAPER 92-1047)

A series of pilot-in-the-loop, dynamic mockup studies is being performed by the Tactical Aircraft Cockpit Study program. Under this program, a series of evaluations has been conducted to investigate pilot-vehicle interface aspects of display format symbology. Evaluations have included the following: the information content and coding requirements of three-color and eight-color

display formats, the utility of several missile launch envelope symbologies, methods for reassigning or reprioritizing designated aircraft within the context of a tactical air combat situation, graphic and textual formats presenting missile evasive maneuver options, and two head-up display formats presenting missile evasion steering guidance. All of these evaluations were part-task experiments; the results have culminated in a 'representative-task', part-mission evaluation of integrated cockpit concepts which represent technologies that are expected to mature by the mid-1990s. Author

**A92-33228#**  
**DESIGN TOOLS FOR EMPIRICAL ANALYSIS OF CREW STATION UTILITIES**

PAUL PENCIKOWSKI (Northrop Corp., Aircraft Div., Hawthorne, CA) AIAA, Aerospace Design Conference, Irvine, CA, Feb. 3-6, 1992. 5 p.

(AIAA PAPER 92-1048) Copyright

The Advanced Crewstation Integration Cockpit (ACIC) is an advanced display system for real-time simulation which features rapid reconfigurability of the aerodynamic, sensor, weapons systems and threat factors figuring in combat scenarios. All ACIC controls and displays are reprogrammable, relocatable, and redefinable with respect to dimensions, operations, and graphics. The incorporation of future developments in expert systems, sensor fusion, and data collection is fully allowed for. Customized performance metrics are both generated and supported by ACIC.

O.C.

**A92-33229#**  
**COMANCHE CREW STATION DESIGN**

BRUCE E. HAMILTON (Sikorsky Aircraft, Stratford, CT) and THOMAS METZLER (USAF, Aviation Systems Command, Saint Louis, MO) AIAA, Aerospace Design Conference, Irvine, CA, Feb. 3-6, 1992. 9 p.

(AIAA PAPER 92-1049) Copyright

The pilot model used in the design of the Comanche attack helicopter's cockpit ensured that the interface for all systems realistically corresponded to pilot tasks, in view of limited cockpit space, mission time pressures, and simultaneous pilot awareness of numerous complex systems requiring 'cognitive engineering'. The cognitive engineering approach gives attention to the interface through which a pilot receives information and conveys intent, within the framework of crew expectations concerning the task structure that must be accommodated by the hardware and software. The interaction between mission analysis, pilot model, and cockpit arrangement ensures support of the physical plant for crew efforts on task operations.

O.C.

**A92-33258\*#** National Aeronautics and Space Administration, Washington, DC.

**THE LUNAR CELSS TEST MODULE**

ALEXANDER HOEHN, SHAWN GOMEZ, and MARVIN W. LUTTGES (Colorado, University, Boulder) AIAA, Aerospace Design Conference, Irvine, CA, Feb. 3-6, 1992. 9 p. Research supported by NASA and Universities Space Research Association. refs

(AIAA PAPER 92-1094) Copyright

The evolutionarily-developed Lunar Controlled Ecological Life Support System (CELSS) Test Module presented can address questions concerning long-term human presence-related issues both at LEO and in the lunar environment. By achieving well-defined research goals at each of numerous developmental stages (each economically modest), easily justifiable operations can be undertaken. Attention is given to the possibility of maximizing non-NASA involvement in these CELSS developmental efforts via the careful definability and modest risk of each developmental stage.

O.C.

**A92-33680**

**A METHOD AND ALGORITHM FOR THE SIMULATION OF A DECISION-MAKING PROCESS BY AN OPERATOR IN CONNECTION WITH THE MONITORING OF COMPLEX SYSTEMS [METOD I ALGORITM MODELIROVANIA PROTSESSA PRINIATIIA RESHENIIA OPERATOROM PRI KONTROLE SLOZHNYKH SISTEM]**

S. N. VOROB'EV, E. S. EGOROV, and E. V. BORISOV (Voennaia Akademiia, Moscow, Russia) Elektronnoe Modelirovanie (ISSN 0204-3572), vol. 14, Jan.-Feb. 1992, p. 86-90. In Russian. refs Copyright

**A92-33802**

**COCKPIT TASK MANAGEMENT - PRELIMINARY DEFINITIONS, NORMATIVE THEORY, ERROR TAXONOMY, AND DESIGN RECOMMENDATIONS**

KEN FUNK (Oregon State University, Corvallis) International Journal of Aviation Psychology (ISSN 1050-8414), vol. 1, no. 4, 1991, p. 271-285. refs

Copyright

A preliminary formalization of the process that flight crews use to initiate, monitor, prioritize, execute, and terminate multiple, concurrent tasks is presented. Key terminology is defined and a preliminary, normative theory of cockpit task management (CTM) is presented. An error taxonomy that is applied to three National Transportation Safety Board aircraft accident reports is introduced. Recommendations for pilot-vehicle interfaces (PVI) intended to facilitate CTM and an example, prototype PVI that was effective in improving CTM performance are provided. In conclusion, the complementary relationship between CTM and cockpit resource management (CRM) is described.

Author

**A92-35426**

**ANNUAL SAFE SYMPOSIUM, 29TH, LAS VEGAS, NV, NOV. 11-13, 1991, PROCEEDINGS**

Yoncalla, OR, SAFE Association, 1992, 310 p. For individual items see A92-35427 to A92-35473.

Copyright

Consideration is given to survival technology restraint improvement program status, an evaluation of three anti-G suit concepts for Shuttle reentry, JPATS escape system development, the next generation data acquisition and storage system (DASS-II) for the hybrid III type manikin, computational analysis of inertial effects on the stability of an ACES II ejection seat, methods for predicting successful ejection seat canopy penetration, and safety considerations for ultrashort-pulse lasers. Attention is also given to a transportable collective protection system, operational and human factor problems in the design of a crewmember negative G restraint, an aircrew cooling system, a chemical defense version of the combat edge system, determination of pyrotechnic functional margin, development of a data acquisition system to measure dynamic oscillatory activity within an aircrew breathing system, echo imaging in decompression sickness research, female tolerance to sustained acceleration, and a laser ordnance initiation system.

O.G.

**A92-35429**

**SURVIVAL TECHNOLOGY RESTRAINT IMPROVEMENT PROGRAM STATUS**

GARY R. WHITMAN (U.S. Navy, Naval Air Development Center, Warminster, PA) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 14-19. refs

Copyright

The Survival Technology Restraint Improvement Program (STRIP) which is a part of the Navy Aircrew Common Ejection Seat (NACES) program is reviewed. The STRIP program is aimed at developing a system for eliminating MA-2 restraint deficiencies and meeting the requirements of future tactical aircraft. The NACES has been incorporated into the T-45A, F-14D, F/A-18C, and F/A-18D, and was designed to interface with the MA-2 Torso Harness. Particular attention is given to the STRIP subsystems and evaluation process established to assess the system.

O.G.

**A92-35431\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

## AN EVALUATION OF THREE ANTI-G SUIT CONCEPTS FOR SHUTTLE REENTRY

R. W. KRUTZ, JR. (Krug Life Sciences, Inc., San Antonio, TX), R. R. BURTON (USAF, Armstrong Aerospace Medical Research Laboratory, Brooks AFB, TX), and C. F. SAWIN (NASA, Johnson Space Center, Houston, TX) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 24-26. refs (Contract F33615-89-C-0603)

Copyright

A study was conducted to compare the standard anti-G launch-entry suit (LES) with a reentry full-coverage anti-G suit (REAGS) and a REAGS without an abdominal bladder (AB). (The inflated AB is the most uncomfortable G-suit component). Intravenous Lasix, a diuretic, was used to induce the fluid loss seen during space flight. Using the Armstrong Laboratory Centrifuge, data collected from seven subjects have shown that less anti-G suit pressure is required to maintain eye-level systolic blood pressure above 70 mmHg when the REAGS or REAGS without AB is worn during simulated shuttle reentry G-profiles when compared to the current LES G-suit. The REAGS without AB was significantly more comfortable than the standard anti-G suit.

Author

**A92-35432**

## THE ADAM/MASE INTEGRATION TESTS - A PROGRESS REPORT

JOHN A. PLAGA (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 27-31. refs

Copyright

The ADAM/MASE integration tests (AMIT) are being conducted to examine the potential of the Advanced Dynamic Anthropomorphic Manikin (ADAM) as an ejection test manikin and data acquisition system and to examine the ability of the Multi-Axis Seat Ejection (MASE) sled to eject seats during straight, level conditions as well as during adverse sled attitudes. Preliminary results indicate there are electronic problems in the ADAM data acquisition system such as central processing board failures and false starts/resets in the data collection due to electro-magnetic interference (EMI); extensive noise in the data; and data offsets due to amplifier saturation. Efforts have already been made to eliminate EMI problems by installing a fiber optic communications cable and developing a personal computer control system for the ADAM.

Author

**A92-35433**

## A COMPARISON OF MANIKIN AND HUMAN DYNAMIC RESPONSE TO +GZ IMPACT

JOHN R. BUHRMAN (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 32-35. refs

Copyright

A series of +Gz impact tests was carried out to test the dynamic response properties of the Advanced Dynamic Anthropomorphic Manikin (ADAM) and to compare ADAM's responses to those of human subjects. The results of these tests are described along with the criteria and data analysis used to evaluate the manikin response properties. Small and large prototype ADAM and Grumman-Anderson Research Dummies (GARD) manikins as well as fourteen human subjects were used in tests. Data obtained indicate that the small ADAM and the two GARD manikins are capable of providing consistent simulation of human z-axis responses. The large ADAM showed a tendency to generate larger peak acceleration and seat force measurements than predicted by the corresponding human data. O.G.

**A92-35435**

## NEXT GENERATION DATA ACQUISITION AND STORAGE SYSTEM (DASS-II) FOR THE HYBRID III TYPE MANIKIN

PAUL H. FRISCH, WILLIAM BOULAY (Applied Physics, Inc., Nanuet, NY), and JOHN QUARTUCCIO (U.S. Navy, Naval Air Development Center, Warminster, PA) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 43-48. Research supported by U.S. Navy.

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The design of the next generation DASS-II to be integrated into the Navy variant of the Hybrid III manikin is considered. It is capable of maintaining representative human anatomic accuracy and biodynamic response characteristics, and is based on the electronics necessary to measure and reconstruct the responses of interest. The DASS-II incorporates an anatomically representative mechanical pelvis, housing a 96-channel analog subsystem in conjunction with a chest-mounted high-speed processor subsystem providing real time data acquisition and data storage. The system is compatible with current telemetry schemes and is powered via internal batteries. The user interfaces with the DASS-II via a dedicated IBM laptop computer to set up system function, extract data, perform calibration, and process manikin response. O.G.

**A92-35438**

## SUSTAINED ACCELERATION - ADAPTATION AND DE-ADAPTATION

ROBERT E. VAN PATTEN (Environmental Tectonics Corp., Southampton, PA) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 82-86. refs

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An anecdotal basis has long been cited as descriptive of the G-adaptation/de-adaptation process ('pulling G's makes you good at pulling G's'). This paper develops a mathematical hysteresis loop model for the process, basing the postulated form of the model on data from Soviet and United States Air Force centrifuge research using animal and human subjects. An attempt to correlate the model with the literature of isometric strength training is discussed. The paper concludes with an outline of a suggested research protocol for centrifuge-based research. The objective of that program would be the development of a pilot G-tolerance enhancement program based upon centrifuge recurrency training.

Author

**A92-35439**

## AN IMPROVED METHOD FOR DETERMINING THE MASS PROPERTIES OF HELMETS AND HELMET MOUNTED DEVICES

JEFFREY M. THORNTON (U.S. Navy, Naval Air Development Center, Warminster, PA) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 87-93. refs

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This paper presents a state-of-the-art mass properties instrument and discusses the methods developed to customize the measuring system for evaluating helmets and helmet mounted devices. The new method is designed to be easily repeated and have a standard coordinate system for all measurements. The test fixtures are designed to enable data measurements necessary for principal mass moments of inertia calculations. The mass properties system is composed of a scale, test fixtures integrated with a KGR30 model mass properties instrument and software developed at the Naval Air Development Center (NADC). Author

**A92-35440**

## COMPUTER MODELING AND SIMULATION IN THE DEVELOPMENT OF USN/USMC PROTECTIVE HEADGEAR SYSTEMS

KARL WERNER (U.S. Navy, Naval Air Development Center, Warminster, PA) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 94-98. refs

Association, 1992, p. 94-97.

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The development of an advanced helmet system with improved performance and protection carried out under the Advanced Aircrew Head Protection Program is considered. Emphasis is placed on the role of computer aided design and analysis in the evaluation of helmet performance during the ejection sequence. It is noted that the computer-aided design and evaluation of USN/USMC candidate helmet concepts will make it possible to easily and economically measure the effectiveness of multiple designs. Initial test cycles are performed in the low-risk environment of computer simulation and analysis, which facilitates the optimization of designs. O.G.

#### A92-35442

##### **SAFETY CONSIDERATIONS FOR ULTRASHORT-PULSE LASERS**

CLARENCE P. CAIN (Krug Life Sciences, Inc., San Antonio, TX) and W. P. ROACH (USAF, Armstrong Aerospace Medical Research Laboratory, Brooks AFB, TX) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 104-106. (Contract F33615-88-C-0631)

Copyright

A study of the safety aspects and requirements for the ultrashort-pulse laser systems was performed to ensure that Air Force and national laser safety standards were met. It is noted that existing standards AFOSH 161-10 and ANSI Z-136 do not address the safety aspects of ultrashort-pulse lasers and it is necessary to extend the database on the propagation, interaction, and damage measurements of short and ultrashort laser pulses in the visible and near-infrared regions of electromagnetic spectrum for ocular and related media. Particular attention is given to the results of setting up the ultrashort laser pulse system and its operating capabilities. O.G.

#### A92-35446

##### **OPTIMIZATION STUDIES ON A 99 PERCENT PURITY MOLECULAR SIEVE OXYGEN CONCENTRATOR - EFFECTS OF THE CARBON TO ZEOLITE MOLECULAR SIEVE RATIO**

GEORGE W. MILLER and CLARENCE F. THEIS (USAF, Armstrong Aerospace Medical Research Laboratory, Brooks AFB, TX) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 137-143. refs

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The effect of the carbon molecular sieve (CMS) to zeolite molecular sieve (ZMS) ratio on the performance of the 99 percent purity molecular sieve oxygen concentrator is analyzed. The carbon to zeolite molecular sieve ratio was varied by changing the molecular sieve bed length. The bed length carbon/zeolite ratios were 1/4, 1/2, 3/4, 1/1, 4/3, 2/1, and 4/1. Results show that the CMS to ZMS bed length ratio significantly affects the performance of the concentrator. The CMS to ZMS bed length ratio of 3/4 maximized the production of 99 percent oxygen. The highest oxygen productivity observed was 0.33. The optimum adsorbents for the 99 percent purity concentrator were OXYSIV-5 ZMS and Takeda 3A CMS. O.G.

#### A92-35447

##### **OPERATIONAL AND HUMAN FACTOR PROBLEMS IN THE DESIGN OF A CREWMEMBER NEGATIVE G RESTRAINT**

TOM ZENOBI (U.S. Navy, Naval Air Development Center, Warminster, PA) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 144-148.

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A development program with the objective of designing and testing a retrofittable and cost effective crewmember negative G restraint was conducted. The restraint also had to offer crewmember comfort and mobility, as well as perform adequately under ejection conditions. The approach to limiting crewmember movement especially his head and design eye position in the

negative Gz direction (acceleration in the upward direction - 'eyeballs up') was to restrain his torso at the shoulders by transmitting his body load to the seat structure. This was done by using seat kit hard points as an attachment point. Although centrifuge tests and flight tests showed the restraint provided excellent negative G restraint, other factors received both positive and negative comments by various evaluators. The end result was that the shoulder restraint approach was terminated and a more conservative approach of improving upon the standard lap belt function is being considered. Author

#### A92-35448

##### **LPAFP - LOW PROFILE AIRCREW FILTER PACK**

PIERRE LEGARE and ROBERT IRONSIDE (Racal Filter Technologies, Ltd., Canada) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 149-155.

Copyright

A low profile aircrew filter pack (LPAFP) developed under the Air Force Human Systems Division, Advance Life Support Systems program is considered. LPAFP was designed as a lightweight, disposable, torso-mounted filter to provide chemical defense protection against an Air Force defined threat for an aircrew. Internal components design was optimized to provide satisfactory filter life and pressure in the smallest volume filter. The filter performance was assessed against design parameters using component brassboard models. O.G.

#### A92-35449

##### **US NAVY AND MARINE CORPS PROGRAMS FOR AIRCREW CHEMICAL-BIOLOGICAL (CB) PROTECTION**

JAMES C. HARDY (U.S. Navy, Naval Air Development Center, Warminster, PA) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 156-161.

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#### A92-35450

##### **AIRCREW COOLING SYSTEM**

CHRISTOPHER A. HEINE (U.S. Navy, Naval Air Development Center, Warminster, PA) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 162-166.

Copyright

The Aircrew Cooling System (ACS) is intended to provide protection for USN/USMC aircrew from performance decrement and heat stress related injury resulting from heat build-up during normal and especially Chemical, Biological and Radiological (CBR) operations in hot environments. ACS will consist of a portable unit that cools and pumps fluid to a cooling vest or shirt located under the flight clothing. The program will evaluate existing commercial microclimate cooling systems for possible aircrew applications. These systems will be evaluated for cooling rate, duration, power consumption, weight, integration with flight gear, supportability and overall effectiveness. From these test results a specification will be formulated and proposals will be requested for evaluation. Author

#### A92-35451

##### **A FORWARD-LEANING SUPPORT SYSTEM AND A BUOYANCY SUIT FOR PILOT ACCELERATION PROTECTION**

CONRAD B. MONSON and WILLIAM J. ADAMS (Rockwell International Corp., El Segundo, CA) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 167-173. refs

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Over the past 7 years, Rockwell has developed two devices for pilot acceleration protection: a Body Support Device (BSD) and a Buoyancy Suit. The BSD positions a pilot in a forward-leaning orientation whereas the Buoyancy Suit surrounds a pilot with water. Tests have shown that subjects using the BSD or wearing a Buoyancy Suit have a significantly higher G tolerance than subjects

using more conventional methods of G protection. A current version of the BSD has been centrifuge tested with promising results.

Author

### A92-35456

#### AN INTEGRATED G-SUIT/PRESSURE JERKIN/IMMERSION SUIT INCORPORATING VAPOUR PERMEABILITY AND AIR COOLING

BRIAN FARNWORTH, DONALD MAH, and PING Y. SHEU (M.E.T.A. Research, Inc., Richmond, Canada) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 195-199.

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A prototype fighter pilot garment system has been developed which integrates g-suit, pressure jerkin, cold water immersion suit, and air cooling. The key feature is the use of an air-impermeable, liquid-water-impermeable, but water-vapor-permeable laminate as the pressure-bladder material. As a cooling air stream passes through the bladders, both heat and water vapor from sweat can pass from the skin into the air stream. Spacer fabric inside the bladders serves both to ensure a passage way for cooling air and to provide insulation on immersion. Lab bench tests indicate that cooling rates of upwards from 150 W/sq m are achievable, though some optimization is required, and that in-water insulation is about 0.1 sq m K/W (0.6 clo).

Author

### A92-35457

#### CHEMICAL DEFENSE VERSION OF THE COMBAT EDGE SYSTEM

SHELDON J. BRUCE and BRIAN D. SPERRY (Boeing Co., Seattle, WA) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 200-212.

Copyright

In 1989 the Combined Advanced Technology Enhanced Design G Ensemble (COMBAT EDGE) Program was initiated for the full scale development of the standard (non-chemical defense) positive pressure breathing system designed under the Tactical Life Support System (TLSS) Program. The TLSS program continued with the design and development of a chemical defense version which would have the same altitude and g protection capability and similar breathing characteristics as COMBAT EDGE. The objective of this final phase of TLSS was to develop test hardware with these features for a USAF evaluation. This paper presents the design description of the chemical defense system and the testing conducted by Boeing before the USAF evaluation. The TLSS design included a chemical defense respirator which incorporated the COMBAT EDGE mask and a hood similar to the one developed on the Aircrew Eye/Respiratory Protection (AERP) Program. A new, low profile chemical defense filter was used which replaces the C2 filter used on the current aircrew system. Also equipment for head and torso cooling to enhance crew comfort was included. Boeing testing comprised cockpit integration at Brooks AFB, and breathing and cooling performance tests at Boeing, Seattle.

Author

### A92-35458

#### AUGMENTED AND ADVANCED HELMETS IN A DYNAMIC ACCELERATION ENVIRONMENT - A SUMMARY OF THE 5TH INTERSERVICE/INDUSTRY ACCELERATION COLLOQUIUM HELD 10 MAY 1991 AT WRIGHT PATTERSON AIR FORCE BASE

TAMARA L. CHELETTE (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) and ERIC J. MARTIN (Systems Research Laboratories, Inc., Dayton, OH) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 213-216.

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### A92-35460

#### ADVANCED RECOVERY SEQUENCER DESIGN, DEVELOPMENT, AND QUALIFICATION

JAMES SCHOEN (McDonnell Douglas Missile Systems Co., Long

Beach, CA) and STAN SMIGIEL (USAF, Human Protection Systems Div., Wright-Patterson AFB, OH) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 223-230.

Copyright

McDonnell Douglas and Hi-Shear Technology Corp. (HSTC), under U.S. Air Force contract, have developed an advanced recovery sequencer (ARS) for the ACES II ejection seat. The ARS uses digital microcontroller technology and solid-state pressure transducers to optimize escape sequence timing. This is achieved by means of a continuously variable time delay for recovery parachute deployment under moderate- to high-speed conditions. This is in contrast to the fixed delay provided by the current analog sequencer. The ARS will also provide a built-in test capability to enhance system reliability and maintainability. This paper presents an overview of the ARS program from initial conception through qualification.

Author

A92-35461\* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

#### VALIDATION OF A DUAL-CYCLE ERGOMETER FOR EXERCISE DURING 100 PERCENT OXYGEN PREBREATHING

JANET F. WIEGMAN, JOHN H. OHLHAUSEN, JAMES T. WEBB (Krug Life Sciences, Inc., San Antonio, TX), and ANDREW A. PILMANIS (USAF, Armstrong Aerospace Medical Research Laboratory, Brooks AFB, TX) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 231-235. refs

(Contract F33615-89-C-0603; NASA ORDER T-82170)

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A study has been designed to determine if exercise, while prebreathing 100 percent oxygen prior to decompression, can reduce the current resting-prebreathe time requirements for extravehicular activity and high altitude reconnaissance flight. For that study, a suitable exercise mode was required. Design considerations included space limitations, cost, pressure suit compatibility, ease and maintenance of calibration, accuracy of work output, and assurance that no significant mechanical advantage or disadvantage would be introduced into the system. In addition, the exercise device must enhance denitrogenation by incorporation of both upper and lower body musculature at high levels of oxygen consumption. The purpose of this paper is to describe the specially constructed, dual-cycle ergometer developed for simultaneous arm and leg exercise during prebreathing, and to compare maximal oxygen uptake obtained on the device to that obtained during leg-only cycle ergometry and treadmill testing. Results demonstrate the suitability of the dual-cycle ergometer as an appropriate tool for exercise research during 100 percent oxygen prebreathing.

Author

### A92-35464

#### OXYGEN PURIFICATION AND COMPRESSION CAPABILITIES OF CERAMIC MEMBRANES

BELINDA F. ROETTGER (Sundstrand Aerospace, Rockford, IL) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 247-252. refs

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Ceramic membrane devices being developed to generate clean, compressed oxygen from ambient air by an electrochemical process are described. NBC-protection capabilities were verified using live chemical agents including the blister agent, HD (Bis (2-chloroethyl) sulfide), the nerve agent GD (pinacolyl methyl phosphonate fluoride), and the nerve agent VX (O-ethyl S-(2-diisopropylaminoethyl) methyl phosphonothiolate). None of the agents were detected in the oxygen product stream. Generation of compressed oxygen using ceramic membranes was demonstrated by extracting oxygen from ambient air at 14.7 psia and compressing the oxygen to 2,515 psia.

O.G.

### A92-35466

#### COMPATIBILITY OF A PRESSURE BREATHING FOR G SYSTEM WITH AIRCREW CHEMICAL DEFENSE



R. L. RUSSELL (USAF, Armstrong Aerospace Medical Research Laboratory, Brooks AFB, TX) and ROBERT S. HOSKINS (USAF, Human Systems Program Office, Brooks AFB, TX) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 258-263. refs

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A study is described which is aimed at determining whether the addition of a chemical defense hood/mask and filter would degrade the acceleration protection provided by a positive pressure breathing for G protection (PBG) system. Six male subjects were fitted with the Combined Advanced Technology Design G Ensemble flight equipment with a new chemical protective hood, integrated terminal block, and low resistance filter. Results obtained indicate that mask and vest pressures closely followed the regulator outlet pressure with less than 0.3 s delay. Average peak relaxed G tolerance was  $7.6 \pm 1.3$  +Gz. The use of PBG offset the additional breathing resistance incurred by using a chemical filter. It is noted that the additional weight of the hood/mask caused five of the subjects to have difficulty keeping their head upright during 9 +Gz exposures. It is concluded that the +Gz protective advantages from PBG are attainable with a chemical defense hood/mask. O.G.

#### A92-35467

##### DEVELOPMENT OF A DATA ACQUISITION SYSTEM TO MEASURE DYNAMIC OSCILLATORY ACTIVITY WITHIN AN AIRCREW BREATHING SYSTEM

EDWARD W. HADE (USAF, Armstrong Aerospace Medical Research Laboratory, Brooks AFB, TX) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 264-267. refs

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A data acquisition system for measuring dynamic oscillatory activity in aircrew breathing systems is described. The system is capable of quantifying and characterizing flutter and provides useful data to test engineers and designers of breathing systems. O.G.

#### A92-35468

##### PERFORMANCE OF THE ADVANCED TECHNOLOGY ANTI-G SUIT (ATAGS) DURING 5.0-9.0 +GZ SIMULATED AERIAL COMBAT MANEUVERS (SACM)

JOSEPH R. FISCHER, JR., KATHRYN E. SOLANA, and LARRY J. MEEKER (USAF, Armstrong Aerospace Medical Research Laboratory, Brooks AFB, TX) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 268-271. refs

Copyright

The performance of ATAGS, a modified version of the uniform pressure suit, under 5.0-9.0 +Gz-plateau SACM conditions is considered. The endurance times from the ATAGS and standard suit runs were compared. A longer endurance time was demonstrated while using the ATAGS than while using the standard anti-G suit (164 s vs 80 s). Results indicate that the ATAGS should afford a significant operational advantage over the standard anti-G suit in a high-G combat environment. O.G.

#### A92-35469

##### TRANSCRANIAL DOPPLER STABILIZATION DURING ACCELERATION AND MAXIMAL EXERCISE TESTS

JEMETT L. DESMOND (Krug Life Sciences, Inc., San Antonio, TX) and PAUL M. WERCHAN (USAF, Armstrong Aerospace Medical Research Laboratory, Brooks AFB, TX) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 272, 273. refs

(Contract F33615-89-C-0603)

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Fabrication, instrumentation techniques, and stabilization methods for transcranial Doppler (TCD) used in aerospace physiological research are discussed. The TCD criteria include subject comfort, focusing ability, signal maintenance, and compatibility with other monitoring devices used during acceleration and exercise related research. O.G.

#### A92-35470

##### G PROTECTIVE EQUIPMENT FOR HUMAN ANALOGS

GRADY L. RIPLEY, DAN L. MATTHEWS (Krug Life Sciences, Inc., San Antonio, TX), and JOHN W. BURNS (USAF, Armstrong Aerospace Medical Research Laboratory, Brooks AFB, TX) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 274-277. Research supported by USAF.

Copyright

Unique aspects of the design, development, and fabrication of animal anti-G garments are discussed. Factors that should be considered for optimal fit and comfort include body shape and size of the animal, the position in which they ride the centrifuge, and the restraint apparatus employed. Taking into account these factors it is necessary to ensure that when the anti-G garment is worn, physiological responses to acceleration in animals are similar to human responses during G. O.G.

#### A92-35472

##### FEMALE TOLERANCE TO SUSTAINED ACCELERATION - A RETROSPECTIVE STUDY

MICHELE D. FISCHER, JANET F. WIEGMAN (Krug Life Sciences, Inc., San Antonio, TX), and DANIEL H. BAUER (USAF, Armstrong Aerospace Medical Research Laboratory, Brooks AFB, TX) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 283-287. refs

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Retrospective data on female and male tolerance to high, sustained acceleration are compared to initiate more extensive research on the female response to the high-G environment. Data obtained show that when a proportionate number of females and males attempted +8 Gz for 15 s run, 63.2 percent of the females, compared to 80.9 percent of the males, completed the run. O.G.

#### A92-35473

##### EXPERIMENTAL TEST RESULTS OF ADVANCED HOLLOW FIBER PERMEABLE MEMBRANES

KEVIN LOZEAU and AL LAMASTRA, JR. (Valcor Engineering Corp., Springfield, NJ) IN: Annual SAFE Symposium, 29th, Las Vegas, NV, Nov. 11-13, 1991, Proceedings. Yoncalla, OR, SAFE Association, 1992, p. 288-295. refs

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Tests aimed at determining the maximum operating parameters of the modified PRISM Alpha hollow fiber permeable membrane air separation module (ASM) are described. Temperature, recovery, and fiber mass per standard cubic foot of nitrogen produced are found to significantly affect the weight of cooling devices, the power drawn from the engine, and the weight of the ASM. A preconditioned inlet air supply was used to control temperature and any liquid or aerosol hydrocarbons. Results show that the maximum operating temperature achieved without degradation was 200 F at an inlet pressure of 120 PSIG. A 27 percent decrease in the fiber mass to product ratio was calculated compared to prior fiber formulations. O.G.

#### A92-35612

##### ON THE PAYLOAD INTEGRATION OF THE JAPANESE EXPERIMENT MODULE (JEM)

HIROSHI INOUE, YOSHIYUKI HASEGAWA (NASDA, Tokyo, Japan), KIYOTSUGU IZUMIZAWA, and HIROAKI YOSHINO (Manned Space Systems, Inc., Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 19, 20. In Japanese.

The payload integration of the Japanese Experiment Module (JEM) is analyzed. The flow chart of the physical integration is presented. Y.P.Q.

#### A92-35628

##### MOTION CONTROL TESTS OF SPACE ROBOTS USING A TWO-DIMENSIONAL MODEL

TADASHI KOMATSU, MICHIOHARA, SHOICHI IKUMI (Tokyo Metropolitan Institute of Technology, Japan), HIROFUMI MIURA, and ISAO SHIMOYAMA (Fujitsu, Ltd., Kawasaki, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 57, 58. In Japanese.

A new approach for the control moment gyro (CMG) and attitude control of the Space Station is suggested. The configurations of a two-dimensional model for the experiment are given. Computational simulations of the model are analyzed. Y.P.Q.

#### A92-35629

##### EVALUATION AND TEST ON HAND CONTROLLERS OF THE JAPANESE EXPERIMENTAL MODULE REMOTE MANIPULATOR SYSTEM (JEMEMS)

TATSUO MATSUEDA, K. KURAOKA (NASDA, Tokyo, Japan), SHOICHI TSUDA, SHIICHIRO NINSHIDA, and M. TANAKA (Toshiba Corp., Kawasaki, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 59, 60. In Japanese. refs

The test objective and methods for the Japanese Experimental Module Remote Manipulator system (JEMEMS) are presented. Evaluation objects of the hand controllers are discussed. The test data are examined. Y.P.Q.

#### A92-35631

##### STUDY ON AIR FLOW ADJUSTMENT FOR TEMPERATURE AND HUMIDITY CONTROL

H. SUGIMOTO and AKIRA MASUMOTO (Kawasaki Heavy Industries, Ltd., Akashi, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 63, 64. In Japanese.

Air flow distribution performance for temperature and humidity control is presented. The air flow distribution variations are discussed. Y.P.Q.

#### A92-35632

##### THE WATER REGENERATING EQUIPMENT FOR A SPACE STATION

ONO SHIGERU, S. INAGAKI, and TOSHIMIZU KANEMURA (NEC Corp., Kawasaki, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 65, 66. In Japanese.

The water regenerating systems for a manned space station are reviewed. The fluid management technologies under microgravity, such as pressure control, flow velocity, and temperature control, are presented. The processing method of the gas components associated with water regeneration is discussed. Y.P.Q.

**A92-35761** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

##### SUPPRESSION OF BIODYNAMIC INTERFERENCE IN HEAD-TRACKED TELEOPERATION

S. LIFSHITZ, S. J. MERHAV, A. J. GRUNWALD (Technion - Israel Institute of Technology, Haifa), G. E. TUCKER (NASA, Ames Research Center, Moffett Field, CA), and M. B. TISCHLER (U.S. Army, Aeroflightdynamics Directorate, Moffett Field, CA) European Rotorcraft Forum, 16th, Glasgow, Scotland, Sept. 18-21, 1990, Paper. 13 p. refs

(Contract NAGW-1128; AF-AFOSR-88-0298)

Results are reported from an experimental simulation study examining improvements achievable in pointing and tracking precision using dynamic display shifting in helmet-mounted displays. The experiment was conducted in a 6-deg-of-freedom motion base simulator with an emulated helmet-mounted sight. It is shown that, for tracking tasks involving continuously moving targets, improvements of up to 70 percent can be achieved in percent on-target dwelling time and of up to 35 percent in rms tracking error, with the adaptive plus low-pass filter configuration. The results

with the same filter configuration for the task of capturing randomly positioned, stationary targets show an increase of up to 340 percent in the number of targets captured and an improvement of up to 24 percent in the average capture time. The adaptive plus low-pass filter combination is considered to exhibit the best overall display dynamics by each of the subjects. P.D.

#### A92-35844

##### SELECTING A STIMULUS SIGNAL FOR LINEAR SYSTEMS ANALYSIS OF THE VESTIBULO-OCULAR REFLEX

EDWARD J. ENGELKEN, KENNETH W. STEVENS (USAF, Aerospace Medicine Directorate, Brooks AFB, TX), and JOHN D. ENDERLE (North Dakota State University, Fargo) IN: Biomedical Sciences Instrumentation. Vol. 28. Research Triangle Park, NC, Instrument Society of America, 1992, p. 31-36. refs Copyright

Three types of stimulus signals were evaluated for use in estimating the transfer function of the vestibulo-ocular reflex. Individual sine-wave, sum-of-sine, and pseudorandom stimuli were used. Five normal human subjects were tested 5 times each using each of the three stimulus types. Frequency domain techniques were used to estimate the transfer function at 0.01, 0.03, and 0.05 Hz. The most consistent estimates were obtained using individual sine-wave stimuli. The pseudorandom signal yielded the most variable estimates. A sum-of-sine stimulus composed of three sine-wave signals provided estimates slightly more variable than the individual sine-wave stimuli, but much less variable than the pseudorandom stimulus. The redundancy of the sine and sum-of-sine stimuli seems to be an advantage by providing stable estimates of the transfer function in the presence of noise.

Author

#### A92-36399

##### RECOMMENDED PRACTICE FOR HUMAN-COMPUTER INTERFACES FOR SPACE SYSTEM OPERATIONS

Research sponsored by AIAA. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, 27 p. refs (AIAA R-023-1992) Copyright

This AIAA Recommended Practice establishes a set of criteria and guidelines for the design of interactive displays which will facilitate the standardization of human-machine tasks associated with space system operations. The focus of this document is on the operational details of the human-computer interfaces as opposed to the structural design of displays. The intent is to structure basic layout, terminology, and symbology principles so that their general standards will be relevant to space system operations. L.M.

**N92-22283\*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

##### MICROBIAL BIOFILM STUDIES OF THE ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM WATER RECOVERY TEST FOR SPACE STATION FREEDOM

E. B. RODGERS, D. C. OBENHUBER, and T. L. HUFF (Sverdrup Technology, Inc., Huntsville, AL.) Apr. 1992 13 p (NASA-TM-103579; NAS 1.15:103579) Avail: NTIS HC/MF A03 CSDL 06K

NASA is developing a water recovery system (WRS) for Space Station Freedom to reclaim human waste water for reuse by astronauts as hygiene or potable water. A water recovery test (WRT) currently in progress investigates the performance of a prototype of the WRS. Analysis of biofilm accumulation, the potential for microbially influenced corrosion (MIC) in the WRT, and studies of iodine disinfection of biofilm are reported. Analysis of WRT components indicated the presence of organic deposits and biofilms in selected tubing. Water samples for the WRT contained acid-producing and sulfate-reducing organisms implicated in corrosion processes. Corrosion of an aluminum alloy was accelerated in the presence of these water samples; however, stainless steel corrosion rates were not accelerated. Biofilm iodine sensitivity tests using an experimental laboratory scale recycled water system containing a microbial check valve (MCV) demonstrated that an iodine concentration of 1 to 2 mg/L was



ineffective in eliminating microbial biofilm. For complete disinfection, an initial concentration of 16 mg/L was required, which was gradually reduced by the MCV over 4 to 8 hours to 1 to 2 mg/L. This treatment may be useful in controlling biofilm formation.

Author

**N92-22290#** Little (Arthur D.), Inc., Cambridge, MA.  
**IMPROVEMENT OF PMN REVIEW PROCEDURES TO ESTIMATE PROTECTIVE CLOTHING PERFORMANCE: EXECUTIVE SUMMARY REPORT Final Report, Sep. 1989 - Sep. 1990**

R. GOYDAN, A. D. SCHWOPE, T. R. CARROLL, and T. J. STOLKI Dec. 1991 45 p  
 (Contract EPA-68-C9-0037)  
 (PB92-105691; ADL-64320-10; EPA/600/2-91/059) Avail: NTIS HC/MF A03 CSCL 05H

In a five-year program performed with the EPA Office of Research and Development, the Chemical Engineering Branch (CEB) of the EPA Office of Toxic Substances has developed state-of-the-art tools for assessing the effectiveness of rubber and plastic protective clothing materials as barriers to chemicals. These tools were developed for use by CEB to conduct more thorough assessments of the potential for occupational exposures to new chemicals as required in the Premanufacture Notification (PMN) review process. The tools include: a computerized model for predicting the permeation of chemicals through common clothing materials using Fickian diffusion theory and the physical property data typically available from a PMN submission; guidelines for specifying permeation testing and interpreting the results of such tests, including development of a new, intermittent chemical contact permeation test method; and a manual that guides the assessment of protective clothing permeation on the basis of published data, data from CEB-prescribed testing and the output of the predictive model. The report describes the development of these tools and lists the products delivered under the project from Oct. 1985 through Sep. 1990. By applying these tools, CEB can perform more thorough and efficient PMN reviews and identify other areas that require improvement in their assessments of chemical protective clothing performance. GRA

**N92-22325\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**NASA HUMAN FACTORS PROGRAMMATIC OVERVIEW**  
 MARY M. CONNORS In NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 434-437 Feb. 1992  
 Avail: NTIS HC/MF A17 CSCL 05H

Human factors addresses humans in their active and interactive capacities, i.e., in the mental and physical activities that they perform and in the contributions they make to achieving the goals of the mission. The overall goal of space human factors in NASA is to support the safety, productivity, and reliability of both the on-board crew and the ground support staff. Safety and reliability are fundamental requirements that human factors shares with other disciplines, while productivity represents the defining contribution of the human factors discipline. Author

**N92-22326\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

**DEVELOPMENT OF AN EMPIRICALLY BASED DYNAMIC BIOMECHANICAL STRENGTH MODEL**  
 A. PANDYA, J. MAIDA, A. ALDRIDGE, S. HASSON (Texas Woman's Univ., Houston.), and B. WOOLFORD In its 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 438-444 Feb. 1992  
 Avail: NTIS HC/MF A17 CSCL 05H

The focus here is on the development of a dynamic strength model for humans. Our model is based on empirical data. The shoulder, elbow, and wrist joints are characterized in terms of maximum isolated torque, position, and velocity in all rotational planes. This information is reduced by a least squares regression technique into a table of single variable second degree polynomial equations determining the torque as a function of position and

velocity. The isolated joint torque equations are then used to compute forces resulting from a composite motion, which in this case is a ratchet wrench push and pull operation. What is presented here is a comparison of the computed or predicted results of the model with the actual measured values for the composite motion. Author

**N92-22327\*#** NTI, Inc., San Antonio, TX.  
**PERFORMANCE ASSESSMENT IN COMPLEX INDIVIDUAL AND TEAM TASKS**

DOUGLAS R. EDDY In NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 445-450 Feb. 1992  
 Avail: NTIS HC/MF A17 CSCL 05H

Described here is an eclectic, performance based approach to assessing cognitive performance from multiple perspectives. The experience gained from assessing the effects of antihistamines and scenario difficulty on C (exp 2) decision making performance in Airborne Warning and Control Systems (AWACS) weapons director (WD) teams can serve as a model for realistic simulations in space operations. Emphasis is placed on the flexibility of measurement, hierarchical organization of measurement levels, data collection from multiple perspectives, and the difficulty of managing large amounts of data. Author

**N92-22330\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**MEASUREMENT OF PERFORMANCE USING ACCELERATION CONTROL AND PULSE CONTROL IN SIMULATED SPACECRAFT DOCKING OPERATIONS**

ADAM R. BRODY (Sterling Software, Moffett Field, CA.) and STEPHEN R. ELLIS In NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 460-466 Feb. 1992 Presented at the Aerospace Sciences Meeting, Reno, NV, Jan. 1991; sponsored in part by AIAA Previously announced in IAA as A91-19464 (AIAA-91-0787) Avail: NTIS HC/MF A17 CSCL 05H

Nine commercial airline pilots served as test subjects in a study to compare acceleration control with pulse control in simulated spacecraft maneuvers. Simulated remote dockings of an orbital maneuvering vehicle (OMV) to a space station were initiated from 50, 100, and 150 meters along the station's -V-bar (minus velocity vector). All unsuccessful missions were reflown. Five way mixed analysis of variance (ANOVA) with one between factor, first mode, and four within factors (mode, block, range, and trial) were performed on the data. Recorded performance measures included mission duration and fuel consumption along each of the three coordinate axes. Mission duration was lower with pulse mode, while delta V (fuel consumption) was lower with acceleration mode. Subjects used more fuel to travel faster with pulse mode than with acceleration mode. Mission duration, delta V, X delta V, Y delta V, and Z delta V all increased with range. Subjects commanded the OMV to 'fly' at faster rates from further distances. These higher average velocities were paid for with increased fuel consumption. Asymmetrical transfer was found in that the mode transitions could not be predicted solely from the mission duration main effect. More testing is advised to understand the manual control aspects of spaceflight maneuvers better. Author

**N92-22339\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

**DESIGN FOR INTERACTION BETWEEN HUMANS AND INTELLIGENT SYSTEMS DURING REAL-TIME FAULT MANAGEMENT**

JANE T. MALIN, DEBRA L. SCHRECKENGHOST, and CARROLL G. THRONESBERRY (Mitre Corp., Houston, TX.) In its 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 530-538 Feb. 1992  
 Avail: NTIS HC/MF A17 CSCL 05H

Initial results are reported to provide guidance and assistance for designers of intelligent systems and their human interfaces. The objective is to achieve more effective human-computer

interaction (HCI) for real time fault management support systems. Studies of the development of intelligent fault management systems within NASA have resulted in a new perspective of the user. If the user is viewed as one of the subsystems in a heterogeneous, distributed system, system design becomes the design of a flexible architecture for accomplishing system tasks with both human and computer agents. HCI requirements and design should be distinguished from user interface (displays and controls) requirements and design. Effective HCI design for multi-agent systems requires explicit identification of activities and information that support coordination and communication between agents. The effects are characterized of HCI design on overall system design and approaches are identified to addressing HCI requirements in system design. The results include definition of (1) guidance based on information level requirements analysis of HCI, (2) high level requirements for a design methodology that integrates the HCI perspective into system design, and (3) requirements for embedding HCI design tools into intelligent system development environments. Author

**N92-22340\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

**A HUMAN FACTORS EVALUATION OF THE ROBOTIC INTERFACE FOR SPACE STATION FREEDOM ORBITAL REPLACEABLE UNITS**

CARLOS E. SAMPAIO, ELLEN Y. HWANG, TERENCE F. FLEMING, MARK A. STUART (Lockheed Engineering and Sciences Co., Houston, TX.), and A. JAY LEGENDRE *In its* 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 539-543 Feb. 1992

Avail: NTIS HC/MF A17 CSCL 05H

An orbital replaceable unit (ORU) is often defined as any orbital unit aboard Space Station with a wearout life of less than 30 years. The capability of successful changeout of these units by remote manipulation is critical to the ORU to telerobot interface design. A human factors evaluation of the selected interface showed certain inadequacies of the alignment target concept that was part of the interface package. Alternative target concepts which addressed these inadequacies were developed and are presented. Recommendations will be incorporated into NASA requirements documents which ORU suppliers and manufacturers must then build to. Author

**N92-22344\*#** Aerospace Medical Research Labs., Wright-Patterson AFB, OH.

**VISUALLY COUPLED SYSTEMS (VCS): THE VIRTUAL PANORAMIC DISPLAY (VPD) SYSTEM**

DEAN F. KOCIAN *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 548-561 Feb. 1992

Avail: NTIS HC/MF A17 CSCL 05H

The development and impact is described of new visually coupled system (VCS) equipment designed to support engineering and human factors research in the military aircraft cockpit environment. VCS represents an advanced man-machine interface (MMI). Its potential to improve aircrew situational awareness seems enormous, but its superiority over the conventional cockpit MMI has not been established in a conclusive and rigorous fashion. What has been missing is a 'systems' approach to technology advancement that is comprehensive enough to produce conclusive results concerning the operational viability of the VCS concept and verify any risk factors that might be involved with its general use in the cockpit. The advanced VCS configuration described here, was ruggedized for use in military aircraft environments and was dubbed the Virtual Panoramic Display (VPD). It was designed to answer the VCS portion of the systems problem, and is implemented as a modular system whose performance can be tailored to specific application requirements. The overall system concept and the design of the two most important electronic subsystems that support the helmet mounted parts, a new militarized version of the magnetic helmet mounted sight and correspondingly similar helmet display electronics, are discussed

in detail. Significant emphasis is given to illustrating how particular design features in the hardware improve overall system performance and support research activities. Author

**N92-22345\*#** Aerospace Medical Research Labs., Wright-Patterson AFB, OH.

**THE EVALUATION OF PARTIAL BINOCULAR OVERLAP ON CAR MANEUVERABILITY: A PILOT STUDY**

BRIAN H. TSOU, BETH M. ROGERS-ADAMS, and CHARLES D. GOODYEAR (Logicon Technical Services, Inc., Dayton, OH.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 562-568 Feb. 1992

Avail: NTIS HC/MF A17 CSCL 05H

An engineering approach to enlarge the helmet mounted display (HMD) field of view (FOV) and maintain resolution and weight by partially overlapping the binocular FOV has received renewed interest among human factors scientists. It is evident, based on the brief literature review, that any panoramic display with a binocular overlap, less than a minimum amount, annoys the viewer, degrades performance, and elicits undesirable behavior. The major finding is that across the 60 deg conditions, subjects moved their heads a greater distance (by about 5 degs on each side) than in the 180 deg condition, presumably to compensate for the lack of FOV. It is quite clear that the study, based on simple car maneuverability and two subjects, reveals differences in FOV, but nothing significant between binocular overlap levels and configurations. This tentatively indicates that some tradeoffs of binocular vision for a larger overall display FOV are acceptable. Author

**N92-22346\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**THREE DIMENSIONAL TRACKING WITH MISALIGNMENT BETWEEN DISPLAY AND CONTROL AXES**

STEPHEN R. ELLIS, MITCHELL TYLER, WON S. KIM, and LAWRENCE STARK (California Univ., Berkeley.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 569-574 Feb. 1992

(Contract NCC2-86)

Avail: NTIS HC/MF A17 CSCL 05H

Human operators confronted with misaligned display and control frames of reference performed three dimensional, pursuit tracking in virtual environment and virtual space simulations. Analysis of the components of the tracking errors in the perspective displays presenting virtual space showed that components of the error due to visual motor misalignment may be linearly separated from those associated with the mismatch between display and control coordinate systems. Tracking performance improved with several hours practice despite previous reports that such improvement did not take place. Author

**N92-22348\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**AN INTELLIGENT CONTROL AND VIRTUAL DISPLAY SYSTEM FOR EVOLUTIONARY SPACE STATION WORKSTATION DESIGN**

XIN FENG, RUSSELL J. NIEDERJOHN (Marquette Univ., Milwaukee, WI.), and MICHAEL W. MCGREEVY *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 582-587 Feb. 1992

(Contract NCC2-681)

Avail: NTIS HC/MF A17 CSCL 05H

Research and development of the Advanced Display and Computer Augmented Control System (ADCACS) for the space station Body-Ported Cupola Virtual Workstation (BP/VCWS) were pursued. The potential applications were explored of body ported virtual display and intelligent control technology for the human-system interfacing applications in space station environment. The new system is designed to enable crew members to control and monitor a variety of space operations with greater

flexibility and efficiency than existing fixed consoles. The technologies being studied include helmet mounted virtual displays, voice and special command input devices, and microprocessor based intelligent controllers. Several research topics, such as human factors, decision support expert systems, and wide field of view, color displays are being addressed. The study showed the significant advantages of this uniquely integrated display and control system, and its feasibility for human-system interfacing applications in the space station command and control environment. Author

**N92-22354\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

**TOXICOLOGICAL APPROACH TO SETTING SPACECRAFT MAXIMUM ALLOWABLE CONCENTRATIONS FOR CARBON MONOXIDE**

K. L. WONG, T. F. LIMERO (Krug Life Sciences, Inc., Houston, TX.), and J. T. JAMES *In its* 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 p 612-619 Feb. 1992

Avail: NTIS HC/MF A17 CSCL 05H

The Spacecraft Maximum Allowable Concentrations (SMACs) are exposure limits for airborne chemicals used by NASA in spacecraft. The aim of these SMACs is to protect the spacecrew against adverse health effects and performance decrements that would interfere with mission objectives. Because of the 1 and 24 hr SMACs are set for contingencies, minor reversible toxic effects that do not affect mission objectives are acceptable. The 7, 30, or 180 day SMACs are aimed at nominal operations, so they are established at levels that would not cause noncarcinogenic toxic effects and more than one case of tumor per 1000 exposed individuals over the background. The process used to set the SMACs for carbon monoxide (CO) is described to illustrate the approach used by NASA. After the toxicological literature on CO was reviewed, the data were summarized and separated into acute, subchronic, and chronic toxicity data. CO's toxicity depends on the formation of carboxyhemoglobin (COHb) in the blood, reducing the blood's oxygen carrying capacity. The initial task was to estimate the COHb levels that would not produce toxic effects in the brain and heart. Author

**N92-22465\*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

**COMPUTER INTERFACES FOR THE VISUALLY IMPAIRED**

GERRY HIGGINS *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 p 359-367 Dec. 1991

Avail: NTIS HC/MF A23 CSCL 05H

Information access via computer terminals extends to blind and low vision persons employed in many technical and nontechnical disciplines. Two aspects are detailed of providing computer technology for persons with a vision related handicap. First, research into the most effective means of integrating existing adaptive technologies into information systems was made. This was conducted to integrate off the shelf products with adaptive equipment for cohesive integrated information processing systems. Details are included that describe the type of functionality required in software to facilitate its incorporation into a speech and/or braille system. The second aspect is research into providing audible and tactile interfaces to graphics based interfaces. Parameters are included for the design and development of the Mercator Project. The project will develop a prototype system for audible access to graphics based interfaces. The system is being built within the public domain architecture of X windows to show that it is possible to provide access to text based applications within a graphical environment. This information will be valuable to suppliers to ADP equipment since new legislation requires manufacturers to provide electronic access to the visually impaired. Author

**N92-22467\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

**MAN/MACHINE INTERACTION DYNAMICS AND PERFORMANCE (MMIDAP) CAPABILITY**

HAROLD P. FRISCH *In* NASA, Washington, Technology 2001:

The Second National Technology Transfer Conference and Exposition, Volume 1 p 375-382 Dec. 1991

Avail: NTIS HC/MF A23 CSCL 05H

The creation of an ability to study interaction dynamics between a machine and its human operator can be approached from a myriad of directions. The Man/Machine Interaction Dynamics and Performance (MMIDAP) project seeks to create an ability to study the consequences of machine design alternatives relative to the performance of both machine and operator. The class of machines to which this study is directed includes those that require the intelligent physical exertions of a human operator. While Goddard's Flight Telerobotic's program was expected to be a major user, basic engineering design and biomedical applications reach far beyond telerobotics. Ongoing efforts are outlined of the GSFC and its University and small business collaborators to integrate both human performance and musculoskeletal data bases with analysis capabilities necessary to enable the study of dynamic actions, reactions, and performance of coupled machine/operator systems. Author

**N92-22480\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**APPLICATIONS OF CELSS TECHNOLOGY TO CONTROLLED ENVIRONMENT AGRICULTURE**

MAYNARD E. BATES (Bionetics Corp., Moffett Field, CA.) and DAVID L. BUBENHEIM *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 p 497-506 Dec. 1991

Avail: NTIS HC/MF A23 CSCL 06K

Controlled environment agriculture (CEA) is defined as the use of environmental manipulation for the commercial production of organisms, whether plants or animals. While many of the technologies necessary for aquaculture systems in North America is nevertheless doubling approximately every five years. Economic, cultural, and environmental pressures all favor CEA over field production for many non-commodity agricultural crops. Many countries around the world are already dependent on CEA for much of their fresh food. Controlled ecological life support systems (CELSS), under development at ARC, KSC, and JSC expand the concept of CEA to the extent that all human requirements for food, oxygen, and water will be provided regenerated by processing of waste streams to supply plant inputs. The CELSS will likely contain plants, humans, possibly other animals, microorganisms and physically and chemical processors. In effect, NASA will create engineered ecosystems. In the process of developing the technology for CELSS, NASA will develop information and technology which will be applied to improving the efficiency, reliability, and cost effectiveness for CEA, improving its resources recycling capabilities, and lessening its environmental impact to negligible levels. Author

**N92-22483\*#** School of Aerospace Medicine, Brooks AFB, TX. Crew Technology Div.

**A 99 PERCENT PURITY MOLECULAR SIEVE OXYGEN GENERATOR**

G. W. MILLER *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 p 523-535 Dec. 1991

Avail: NTIS HC/MF A23 CSCL 06K

Molecular sieve oxygen generating systems (MSOGS) have become the accepted method for the production of breathable oxygen on military aircraft. These systems separate oxygen for aircraft engine bleed air by application of pressure swing adsorption (PSA) technology. Oxygen is concentrated by preferential adsorption in nitrogen in a zeolite molecular sieve. However, the inability of current zeolite molecular sieves to discriminate between oxygen and argon results in an oxygen purity limitations of 93-95 percent (both oxygen and argon concentrate). The goal was to develop a new PSA process capable of exceeding the present oxygen purity limitations. A novel molecular sieve oxygen concentrator was developed which is capable of generating oxygen concentrations of up to 99.7 percent directly from air. The process is comprised of four absorbent beds, two containing a zeolite

molecular sieve and two containing a carbon molecular sieve. This new process may find use in aircraft and medical breathing systems, and industrial air separation systems. The commercial potential of the process is currently being evaluated. Author

**N92-22735\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**DYNAMIC INTER-LIMB RESISTANCE EXERCISE DEVICE FOR LONG-DURATION SPACE FLIGHT**

DOUGLAS F. SCHWANDT, DONALD E. WATENPAUGH, SCOTT E. PARAZYNSKI, and ALAN R. HARGENS *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 p 533-537 Dec. 1991  
 Avail: NTIS HC/MF A22 CSCL 05H

Essential for fitness on Earth, resistive exercise is even more important for astronauts, who must maintain muscle and bone strength in the absence of gravity. To meet this need, designers and scientists at NASA Ames Research Center, Life Science Division, have worked to develop more effective exercise devices for long-duration exposure to microgravity. One of these concepts is the Inter-Limb Resistance Device which allows the subject to exercise one limb directly against another, strengthening muscle groups in the arms, legs, and back. It features a modular harness with an inelastic cable and instrumented pulley. Forces similar to other high resistance exercise equipment are generated. Sensors in the pulley measure force and velocity for performance feedback display and data acquisition. This free-floating apparatus avoids vibration of sensitive experiments on board spacecraft. Compact with low mass, this hardware is also well suited for a 'safe haven' from radiation on board Space Station Freedom, and may prove useful in confined environments on Earth, such as Antarctic stations, submarines, and other underwater habitats. Potential spin-offs of this technology include products for personal strengthening and cardiovascular conditioning, rehabilitation of hospital patients, fitness exercise for the disabled, and retraining after sports injuries. Author

**N92-23218#** Joint Food and Agriculture Organization - International Atomic Energy Agency, Vienna (Austria). Div. of Nuclear Techniques in Food and Agriculture.

**FOOD IRRADIATION NEWSLETTER, VOLUME 15, NUMBER 2**

Oct. 1991 62 p  
 (DE92-614951; INIS-MF-13047-VOL-15-NO-2) Avail: NTIS HC/MF A04

This newsletter contains brief summaries of three coordinated research meetings held in 1991: irradiation in combination with other processes for improving food quality; application of irradiation technique for food processing in Africa; and food irradiation programme for Middle East and European countries. The first Workshop on Public Information on Food Irradiation is summarized, and a Coordinated Research Programme on Irradiation as a Quarantine Treatment of Mites, Nematodes, and Insects other than Fruit Fly is announced. This issue also contains a report on the status of food irradiation in China, and a supplement lists clearances of irradiated foods. DOE

**N92-23513#** Maryland Univ., Baltimore.

**STRESS EFFECTS OF HUMAN-COMPUTER INTERACTIONS Final Report**

H. H. EMURIAN Oct. 1991 60 p Sponsored in part by National Inst. for Occupational Safety and Health, Cincinnati, OH (Contract PHS-OH-02614-01A1)  
 (PB92-136001) Avail: NTIS HC/MF A04 CSCL 05H

Experiments were carried out to investigate the effects of human/computer interactions on indicators of stress. Men solved 50 database queries consecutively presented on a video display terminal (VDT). Each query required solution within 45 seconds of its initial presentation to avoid a reduction in potential earnings. A solution required the correct selection of three successive hypertext indices hierarchically structured from the query to the data answer. In a second study, 16 men and 16 women solved 80 database queries under conditions of high or low work density. The results indicated that motivated time pressure work at a VDT will produce

tonic elevations over a resting baseline in blood pressure, heart rate, and masseter electromyogram (EMG) activity in men and women who are experienced computer users. A relationship exists between the personality of the computer user and the magnitude of systolic blood pressure. Under conditions of 8 second constant and 8 second variable system response times (SRTs) in men, the constant and variable SRTs did not differentially affect physiological responses. Men and women showed higher systolic blood pressure during high density work than during low density work. Females showed reliably greater masseter EMG activity during high density work than during low density work. Author

**N92-24022#** Food and Agriculture Organization of the United Nations, Rome (Italy).

**IRRADIATION OF SPICES, HERBS, AND OTHER VEGETABLE SEASONINGS: A COMPILATION OF TECHNICAL DATA FOR ITS AUTHORIZATION AND CONTROL**

Feb. 1992 52 p Prepared in cooperation with International Atomic Energy Agency, Vienna, Austria and World Health Organization, Geneva, Switzerland  
 (DE92-619064; IAEA-TECDOC-639) Avail: NTIS HC/MF A04

This publication contains a compilation of all available scientific and technical data on the irradiation of spices, herbs and other vegetable seasonings. It is intended to assist governments in considering the authorization of this particular application of radiation processing of food and in ensuring its control in the facility and the control of irradiated food products moving in trade. The Compilation was prepared in response to the requirement of the Codex General Standard for Irradiated Foods and associated Code that radiation treatment of food be justified on the basis of a technological need or of a need to improve the hygienic quality of the food. It was prepared also in response to the recommendations of the FAO/IAEA/WHO/ITC-UNCTAD/GATT International Conference on the Acceptance, Control of and Trade in Irradiated Food (Geneva, 1989) concerning the need for regulatory control of radiation processing of food. It is hoped that the information contained in this publication will assist governments in considering requests for the approval of radiation treatment of spices, herbs and other vegetable seasonings, or requests for authorization to import such irradiated products. DOE

**N92-24044\*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

**PROSTHETIC HELPING HAND Patent Application**

THOMAS W. VEST, inventor (to NASA) (MSI Electronics, Inc., Woodside, NY.), JAMES R. CARDEN, inventor (to NASA), WILLIAM E. NORTON, inventor (to NASA), and JEWELL G. BELCHER, inventor (to NASA) 7 Feb. 1992 12 p  
 (NASA-CASE-MFS-28430-1; NAS 1.71:MFS-28430-1; US-PATENT-APPL-SN-832569) Avail: NTIS HC/MF A03 CSCL 06C

A prosthetic device for below-the-elbow amputees, having a C-shaped clamping mechanism for grasping cylindrical objects, is described. The clamping mechanism is pivotally mounted to a cuff that fits on the amputee's lower arm. The present invention is utilized by placing an arm that has been amputated below the elbow into the cuff. The clamping mechanism then serves as a hand whenever it becomes necessary for the amputee to grasp a cylindrical object such as a handle, a bar, a rod, etc. To grasp the cylindrical object, the object is jammed against the opening in the C-shaped spring, causing the spring to open, the object to pass to the center of the spring, and the spring to snap shut behind the object. Various sizes of clamping mechanisms can be provided and easily interchanged to accommodate a variety of diameters. With the extension that pivots and rotates, the clamping mechanism can be used in a variety of orientations. Thus, this invention provides the amputee with a clamping mechanism that can be used to perform a number of tasks. NASA

**N92-24056\*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

**BAR-HOLDING PROSTHETIC LIMB Patent Application**

THOMAS W. VEST, inventor (to NASA) (MSI Electronics, Inc.,

Woodside, NY.), WILLIAM E. NORTON, inventor (to NASA), JEWELL G. BELCHER, inventor (to NASA), and JAMES R. CARDEN, inventor (to NASA) 15 Apr. 1992 11 p (NASA-CASE-MFS-28481-1; NAS 1.71:MFS-28481-1; US-PATENT-APPL-SN-873931) Avail: NTIS HC/MF A03 CSCL 06C

A prosthetic device for below-the-elbow amputees is disclosed. The device has a removable effector, which is attached to the end of an arm cuff. The effector is comprised of a pair of C-shaped members that are oriented so as to face each other. Working in concert, the C-shaped members are able to hold a bar such as a chainsaw handle. A flat spring is fitted around the C-shaped members to hold them together. NASA

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### SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

**N92-23429\*#** National Aeronautics and Space Administration, Washington, DC.

#### **PUBLICATIONS OF THE EXOBIOLOGY PROGRAM FOR 1990: A SPECIAL BIBLIOGRAPHY**

Mar. 1992 54 p Prepared in cooperation with George Washington Univ., Washington, DC  
(Contract NASW-4324)  
(NASA-TM-4364; NAS 1.15:4364) Avail: NTIS HC/MF A04 CSCL 06A

The Exobiology Program is an integrated program designed to investigate and understand those processes related to the origin, evolution, and distribution of life in the universe. The Exobiology Program is broad in scope, covering the following subject areas: cosmic evolution of biogenic compounds; prebiotic evolution; early evolution of life; evolution of advanced life; solar system exploration; search for extraterrestrial intelligence; planetary protection; and advanced programs in biological systems research. A listing of the 1990 publications resulting from research supported by the Exobiology Program is presented. D.R.D.

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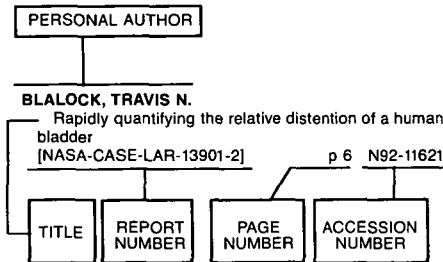
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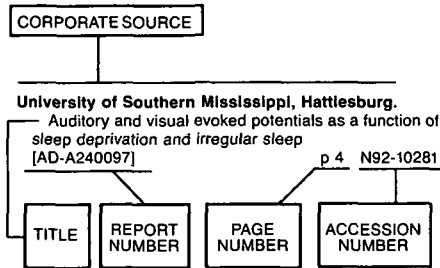
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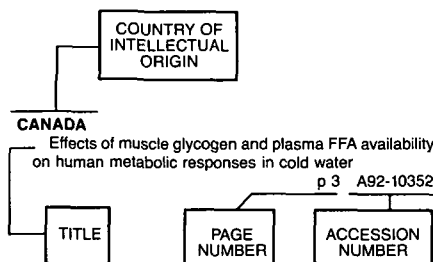


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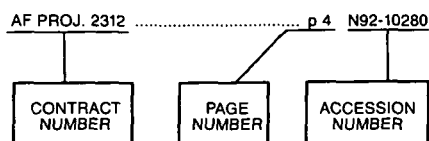
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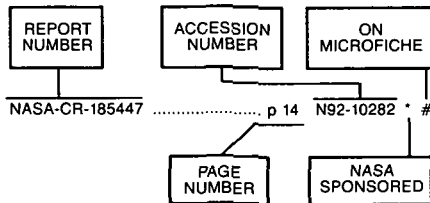
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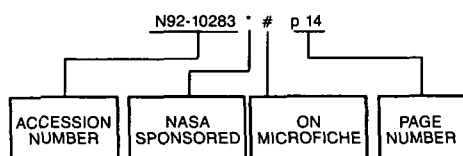
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